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Double Bitted Axes of the Fourche Maline: Use-Wear Analysis and Experimental Replication

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Double Bitted Axes of the Fourche Maline:
Use-Wear Analysis and Experimental Replication

Double Bitted Axes of the Fourche Maline:
Use-Wear Analysis and Experimental Replication

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Art in Anthropology

by

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University of Missouri – St Louis
Bachelor of Arts in Anthropology, 2005

May 2014

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This thesis is approved for the recommendation to the Graduate Council.

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Abstract

This research examines the Fourche Maline double bitted tools from the Fourche Valley site, 3YE948, in Yell County, Arkansas. The assemblage consists of 65 tools surface collected from the site, which vary in form, condition, material composition and wear. Microscopic use-wear on these artifacts was analyzed using high resolution epoxy casts and complemented by a collection of experimental replicas which served as an analytical control. The use-wear analysis of the double bitted tools provides information as to the tool function, the relation between tool form and function, and the life cycle of these tools.

Acknowledgements

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Thank you to all of my colleagues, friends and family who have supported me through this project with needed advice, or a listening ear. Thanks to the volunteers who provided their time and energy to utilize the experimental collection. Special thanks to Nicole Schuler for dedicating her time, energy, enthusiasm and blood to this project.

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I. Introduction and Background

This thesis looks to provide insight into the Fourche Maline culture by looking at the double bitted tools within the lithic assemblage of the Fourche Valley site (3YE0948). The function of these tools has been debated for years without the benefit of a functional analysis. This research provides such an examination. This study's goal is an evaluation of how these tools were used and maintained and to describe tool life cycle and length of use. This collection of stone tools is investigated to establish if tool form determines function and if material composition influences use.

This research was done through the use of high resolution casts and experimental replication. High resolution epoxy casts accurately document microscopic use-wear and are the only practical way to evaluate these large tools with a binocular microscope. A comparative experimental collection of the double bitted tools was created and used to replicate use-wear. The experimental collection shows how these tools were potentially created, hafted and used.

Major questions resolved in this study are:

1. How accurate is the high resolution casting process for microscopic use-wear on non-chert prehistoric tools? What errors occur and how can these be avoided?
2. How does the experimental use-wear compare with the archaeological collection?
What does the experimental field work potentially show about the use of these tools?
3. What was the main purpose of these tools? Were they single- or multi-functional?
Were these tools used extensively or were they disposed of after initial usage?
4. Do the tool forms serve separate purposes, or did modifications extend the life of the tool? Can the life cycle of these tools be reconstructed from the archaeological collection?

This thesis first briefly discusses Fourche Maline culture and the Fourche Valley site in Chapter 1. Chapter 2 describes the categories the collection was separated into based on tool form and material composition. Chapter 3 describes the microscopic use-wear analysis, the high resolution casting process and the creation of the experimental replicas for comparative analysis. Chapter 4 describes the wear seen on both the experimental replicas and archaeological collection by using the categories from Chapter 2. Chapter 5 interprets the data from Chapter 4 based off of the experimental replica wear and observations from the field. Finally, Chapter 6 concludes the thesis with a description of the work which was done and discusses recommendations for further work. All images in this thesis were taken by the author unless otherwise stated. Images were taken either at the University of Arkansas or on the experimental sites.

The Fourche Maline

Schambach (2002) describes Fourche Maline as residing within the Trans-Mississippi South in western Arkansas, eastern Oklahoma, south central Missouri, northwest Louisiana and northeast Texas (Figure 1). The culture dates to the Woodland Period circa 300 B.C to A.D. 900 (Leith 2011). The Fourche Maline are the foundation of the subsequent complex Mississippian cultures in the Trans-Mississippi South (Schambach 1982). Leith argues that the Fourche Maline were “transegalitarian complex hunter-gatherer-horticulturists” (2011; 186) who were adjusting to changes in social complexity, subsistence, settlement patterns and technological changes.

Fourche Maline habitation sites include large middens and surface features such as burials and hearths (Fauchier 2010; Bell 1953; Galm 1984). Fourche Maline material culture consists of plain, robust ceramics with flat-bottom, flower-shaped jars and contracting stem Gary projectile points. Coarsely chipped stone tools, the focus of this study, were originally thought to

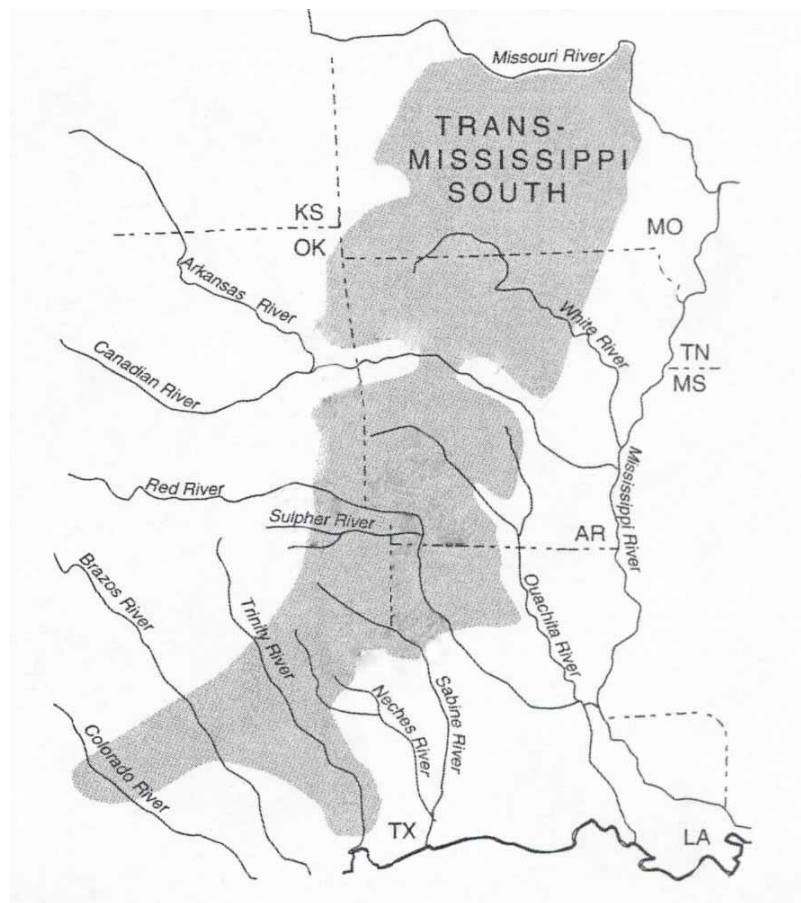


Figure 1. The Trans-Mississippi South as described by Schambach (2002, 2001)

be double-bitted axes but since have been considered as possibly garden hoes are a hallmark tool form (Baerreis 1959; Bell 1953; Schambach 1982, 1998, 2002).

The Fourche Valley Site

The Fourche Valley site, 3YE0948, is near Hot Springs, Arkansas in the center of the state. This multicomponent site has a few projectile points of the Archaic periods but the majority of the material remains comes from the Woodland Period. The site was originally discovered by the landowner, Darrel Smith. The Fourche Valley site was first officially documented in July 2003 at Mr. Smith's request. The site had previously been under agricultural cultivation but is currently in pasture.

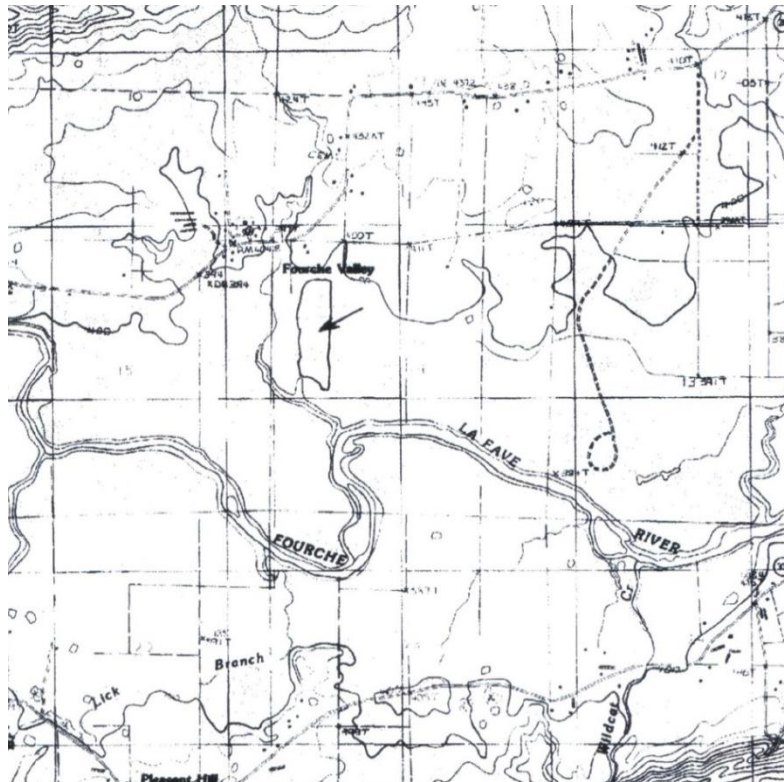


Figure 2. Location of the Fourche Valley Site, 3YE0948 (Survey Report 2006)

The site occupies the north and south sides of an old meander of the Fourche La Fave River (Figure 2). The site consists of four distinct areas, three on the north side and one on the south side (Figure 3). Secondary field investigations were done at the site in 2006 by Larry Porter and Matt Reynolds of the Arkansas Archaeological Survey (Survey Report 2006). During this investigation, the large midden was found in Fields A and B on the northern portion of the site.

Cultural material has been collected from various locations on the site and consists of prehistoric lithics, ceramics, and faunal remains. Lithic material from the site consisted of not only the double bitted tools, but also a variety of dart and arrow points made of novaculite and silicified sandstone. Historic remains present were ceramics, metals and one musket ball.

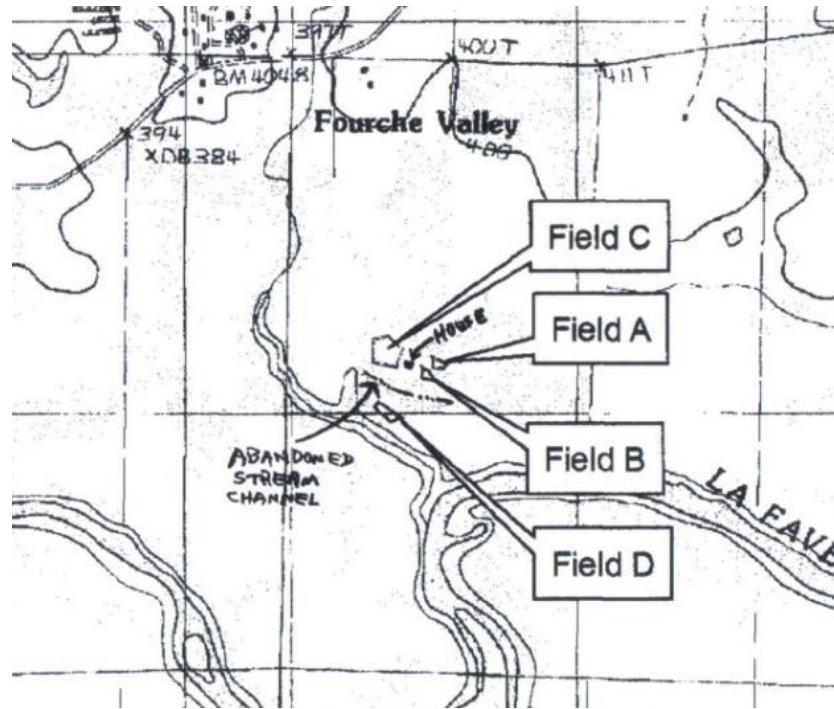


Figure 3. Fourche Valley site location with the four separate field areas (Survey Report 2006) .

Fourche Maline Double Bitted Tools

The double bitted chipped stone tools mark the early stages of the Fourche Maline culture (Schambach 2002). The two main theories for their function are axes for woodwork or agricultural hoes for cultivation (Schambach, 2002; Hoffman, 1977).

The hypothesis that these tools are agricultural hoes is based off of the subsistence practices from the Woodland period (Schambach 1998, 2002; Leith 2011). Schambach reasons while the tools are heavily concentrated in the first three Fourche Maline phases, they rapidly fell out of favor during the fourth phase with the adoption of heavy corn agriculture from the American Bottom region (Table 1).

Time Period	Phase		Period	Culture
A.D 1100			Mississippian	Caddoan
A.D. 1000	Evans phase		Woodland	Fourche Maline IV
A.D. 900				
A.D. 800	Akers phase			Fourche Maline III
A.D. 700				
A.D. 600				
A.D. 500	Scott phase			Fourche Maline II
A.D. 400				
A.D. 300				
A.D. 1	Williams phase			Fourche Maline I
300 B.C.				
1500 B.C			Late Archaic	

Table 1. Fourche Maline phases adapted from Leith 2011

Schambach's hypothesizes the double bitted tools were used as hoes in the cultivation of the starchy and oily seed plants, such as maygrass, chenopodium, squash, and marshelder, which require the use of hoe like tools to till the soil. The abandonment of the tools in the fourth phase suggests a change in technology needed when the starchy seed crop subsistence was replaced by corn agriculture (Schambach 2002). Corn production does not require complex implements and can be grown with simple digging tools and slash and burn techniques (Schambach 2002).

The distinctive axe-like shape and lack of material evidence cause other to argue these chipped stone tools were used for woodworking (Galm 1984, Bell 1953, Schambach 1982). The tools resemble other axe forms in North American prehistory, with concave central groves that facilitate hafting in an axe-like fashion, but would provide little advantage to agricultural hoes (Bell and Dale 1953; Brown 1996). Archaeological investigations of Fourche Maline sites have yet to reveal a tool considered adept for large scale woodworking, such as a the large celts used by nearby groups (Schambach 1999).

II. Fourche Valley Archaeological Collection and Tool Categories

The Collection

The 65 chipped stone artifacts from the Fourche Valley site vary in materials, shapes and sizes (Table 2 and Table A-1 located in Appendix 1 and Appendix 2 for the collection catalog). The dominant tool form is the double bitted consisting of 37 (57% of the entire collection) tools. Other tools forms in the collection are 5 single bitted artifacts (8% of the entire collection), 5 elongated tools (8% of the entire collection), 8 practice pieces/toys (12% of the entire collection), and 10 damaged (15% of the entire collection) tools which the original form could not be determined. The largest complete artifact, (#020) weighs 444.2 grams and the smallest complete artifact (#067) 88.9 grams. Fragmentary damaged specimens consist on 30 tools (46% of the entire collection) in the collection with the original form of 10 of those tools (15% of the entire collection) unable to be determined.

Fifty-two (80% of the entire collection) of the tools in the Fourche Valley collection are composed of silicified sandstone with one (2% of the entire collection) tool made of chert, two (3% of the entire collection) of slate and ten (15% of the entire collection) of sandstone. This Ouachita Mountains location has abundant lithic resources for the Fourche Maline people to have chosen. Local cryocrystalline silicates consist of novaculite, rhyolite, Gasconade chert, Roubidoux chert and other forms. Many of these resources were exploited in stone tool production of small points to agricultural hoes. Fourche Maline people choose silicified sandstone to be the material for the double bitted tools (Schambach, 1998, 2002). While the silicified sandstone can be accessed within the Fourche Valley, it can only be obtained off site and the people living there had to intentionally collect it.

	Artifact	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Count
Practice Pieces or Toys						8
Largest	Artifact 020	444.2	101.2	97.7	34.7	
Smallest	Artifact 030	97.1	89.5	66.5	17.1	
Double Bitted - Triangular						5
Largest	Artifact 001	189.9	118.4	64.9	25.8	
Smallest	Artifact 003	116.6	105.7	61.3	18.9	
Double Bitted - Rounded						10
Largest	Artifact 011	188.9	100.4	69.2	24.3	
Smallest	Artifact 002	99.2	90.5	55.0	18.0	
Damaged Double Bitted						20
Largest	Artifact 016	270.6	83.8	71.0	32.8	
Smallest	Artifact 047	23.6	45.1	29.5	14.7	
Single Bitted						6
Largest	Artifact 035	154.2	89.3	63.3	38.6	
Smallest	Artifact 039	34.3	50.9	45.0	13.8	
Elongated						5
Largest	Artifact 008	167.6	100.0	47.6	33.9	
Smallest	Artifact 052	29.4	58.0	31.0	15.3	
Damaged						10
Largest	Artifact 064	102.4	48.4	66.7	20.6	
Smallest	Artifact 050	28.2	29.6	54.4	16.7	

Table 2. Largest and smallest tools in the Fourche Valley site categories

The double bitted tools appear to be hastily made with little aspect of design. The tools are usually thick and chunky mostly likely due to the material used. Their lack of artistic quality indicates manufacture over a short period of time and for strictly utilitarian needs. I assume that

the main reduction and perhaps even the manufacture of the tools occurred off site at a quarry where the tools would at least have been heavily reduced, if not almost completely manufactured.

The collection was separated into different categories based off of form to identify patterns in tool form. Some of the categories were also split into two groups, those with rounded tool edges from those with sharper, triangular tools edges, as tool edge form potentially varies with use history. Sharper triangular tool edges might reflect their initial shape or sharpening prior to abandonment as they tend to have less wear macroscopically. Rounded tool edges are more heavily used with multiple periods of grinding or re-sharpening and tend to have visible polish and significant smoothing in the hafting regions. Table 3 lists the categories for the Fourche Valley collection.

Practice Pieces or Toys

These eight artifacts are crudely shaped in the double bitted form (Figure 4) and are among the largest in the collection. The practice piece category is mostly made of sandstone (two of silicified sandstone (25% of the category) and six of sandstone (75% of the category)) with indistinct knapping and are as much ground as chipped with tool edges and hafting regions lacking definition. This category is truly distinct from the other groups in the collection. That these tools are primarily sandstone is noteworthy since sandstone shapes easier than silicified sandstone without holding a sharper edge. The tools lack the final steps evident in the others to refined edges and complete tool form. Surprisingly, tools in this category have heavy wear and rounded tool edges. Their edges have significant microscopic grinding wear, more likely the result of manufacture than from use.

Material	Preforms	Double Bitted	Double Bitted	Double Bitted - Damaged	Single Bitted	Bifacial	Bifacial	Damaged - style not determined
		Triangular Edged	Rounded Edged	All Rounded Edged	All Rounded Edged	Triangular Edged	Rounded Edged	
Silified	018	001	002	015	034	033	008	031
Sandstone	068	003	004	016	035	041	052	032
		009	005	024	039		053	036
		012	006	025	042			038
		061	007	026	046			043
			010	027				044
			011	028				049
			023	029				050
			067	037				051
				045				064
				047				
				048				
				057				
				058				
				059				
				066				
Sandstone	013		065	014				
	017			056				
	020			060				
	030							
	055							
	062							
Chert			022					
Slate				063	040			

Table 3. Fourche Valley archaeological collection form and material categories



Figure 4. Practice Pieces or Toys category of the Fourche Valley archaeological collection.

Double Bitted

The double bitted tool category is the hallmark shape of the collection and 16 tools (25% of the entire collection) fall within it. These tools are mostly complete with both bit edges and the central hafting intact and 14 are fashioned from silicified sandstone, (88% of the category), one of sandstone (2% of the category) and one of chert (2% of the category). Some have minimal damage on one or both bits; however, the original tool form can be determined. Five triangular edge tools (31% of the category) are presented in Figure 5, and 11 rounded double bitted tools (69% of the category) in Figure 6.

The triangular double bitted tools have little macro evidence of smoothing on either the edges or the central hafting portions. Tools in this category are potentially newly knapped or recently re-sharpened with minimal use prior to abandonment.

The rounded double bitted tools have smoother edges, potentially due to heavy use prior to abandonment. Edges have been heavily ground through periods of re-sharpening and the hafting portions are usually pronounced and smooth. Most of these tools show polish associated with use especially in the haft.

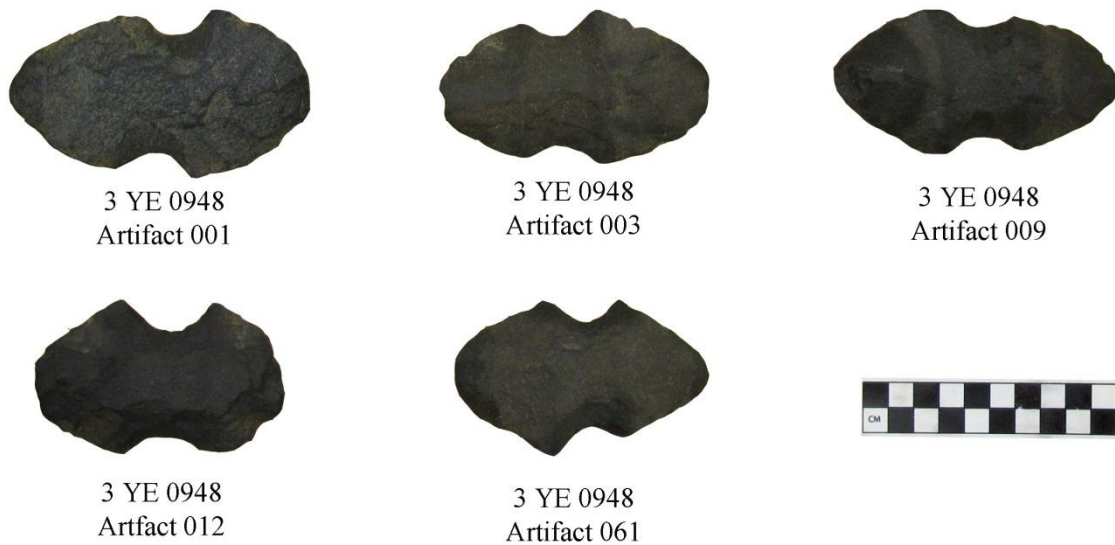


Figure 5. Double Bitted tools with triangular edges category of the Fourche Valley archaeology collection.



Figure 6. Double Bitted tools with rounded edges category of the Fourche Valley archaeological collection.

Double Bitted – Damaged

The 20 damaged double bitted tools are the most numerous (31% of the entire collection) and are presented in Figure 7. Included are tools with only one bit and partial hafting and tools without the bits but having the central hafting. All damaged tools with intact bits have rounded smoother edges consistent with heavy use rather than manufacture. The edges have significant damage and hafting portions are deep, smooth and worn. Sixteen of these tools are silicified sandstone (80% of the category), three of sandstone (15% of the category) and one of slate (.05% of the category).

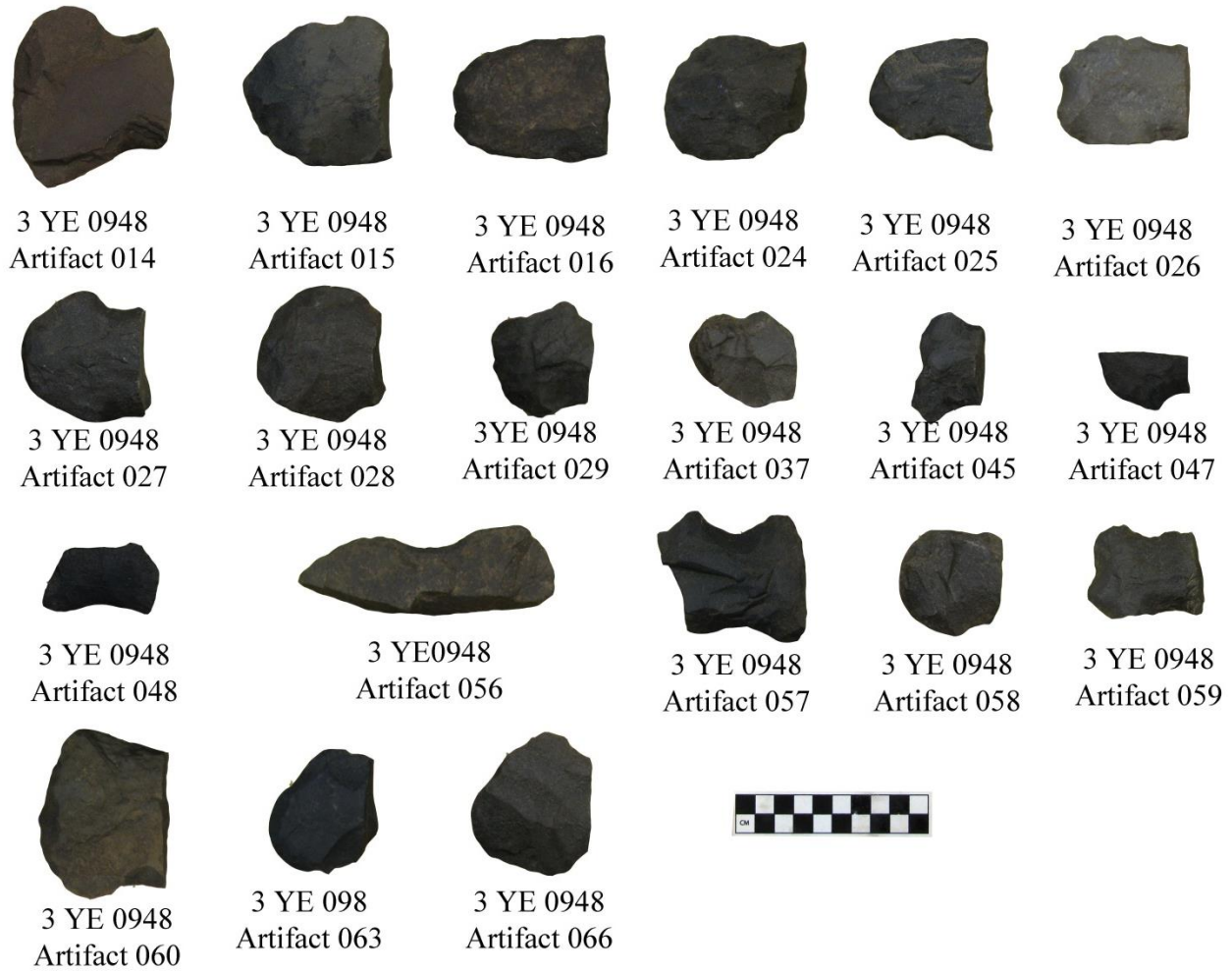


Figure 7. Damaged Double Bitted category from the Fourche Valley archaeological collection

Single Bitted

Six single bitted tools potentially were originally double bitted forms and are presented in Figure 8 (.09% of the entire collection). These tools' distinct shape has rounded bit edges that tapers into a tear-drop shape with a smaller tip at the end; again supporting the idea that they were further along in the production chain with greater use. This form is composed of five tools of silicified sandstone (83% of the category) with one tool (17% of the category) made of slate.



Figure 8. Single Bitted tool category of the Fourche Valley archaeological collection.

Elongated

The five elongated tools are of silicified sandstone (.07% of the entire collection) (Figure 9). Originally they were most likely double bitted, but through extended use, these tools no longer have the distinct double bit and are oblong in shape. Two have triangular shaped edges, the other more rounded. The majority of the tools are quite thick in the central portion.

Damaged

This category consists of ten tools damaged to the point the original form cannot be determined (15% of the entire collection) (Figure 10). Only bit edges remain with no central haft areas and damage most likely rendered the tools useless. Tools in this category are silicified sandstone and have extensive use-wear. The most damage is bending fractures, suggesting breakage during impact.



Figure 9. Elongated category of the Fourche Valley archaeological collection.



Figure 10. Damaged category of the Fourche Valley archaeological collection.

III. Methods

Use-wear Analysis

The technique of microwear analysis was first popularized in Russia by S. A. Semenov in 1957 and, when translated into English in 1964, created a sensation. Semenov presented work based on high resolution magnification, over 100x, as a way to observe striations and polishes on stone tools. Lawrence H. Keeley's (1980, 1974) work with high power microscopic analysis looks at the micropolishes and other wear patterns to identify contact material. Kay (2000) reasons a mixing of the two methods plus lower magnification analysis of edge wear and alterations is the most productive way for use-wear analysis.

With the advancement of modern technology and the development of new techniques, the past thirty years have seen a dramatic shift in how use-wear on lithic material is achieved (Igreja 2009). While lithic analysis is certainly not a new branch of archaeological research, the majority of the work has focused on chert and similar cryptocrystalline silicates. The techniques and methods for chert based tool production analysis have been well established and give accurate, reproducible data; however, tools made of non-chert materials have been severely underrepresented in the analysis of stone technology (Igreja 2009). Tools composed of other materials, such as quartz, quartzite, or sandstone are usually excluded from use-wear studies mainly due to the physical properties of the material (Igreja 2009). These properties cause most non-chert material to be incapable of easy analysis under a microscope, and therefore limit the knowledge about procurement, production and use of these materials. However, recent work in the past ten years enables innovation of new techniques for the analysis of use-wear of non-chert materials (Igreja, 2009; Rots 2010).

Microscopy

This study employed a reflected-light differential-interference microscope with polarized light Nomarski optics to document and observe use-wear at multiple magnifications of 100x, 200x and 400x (Hoffman and Gross 1970, Kay 2000, Igreja 2009). “This microscope is ideally suited for this analysis because it provides a high resolution, three dimensional image of micro-topography” (Kay 2000) and highlights the differences between higher and lower elevations on a tool. For this study, surface scans for use-wear were done at 100x magnification with the higher magnifications of 200x and 400x used for in depth analysis. Casts were scanned systematically starting from one edge and then moving in an up-down, left-to right pattern to ensure that all major use-wear would be seen. Areas near the tool edge or locations with high elevations were inspected as these locations provide the greatest quantity of wear.

Major areas of use-wear or locations of unique or unusual wear were documented using a digital Cannon 18 megapixel camera modified to attach directly to the microscope. The digital camera greatly improved the documentation of use-wear for this project by allowing images to be seen in real time as well as improving documentation and editing. The image location, the number of images, the magnification, the orientation of the cast and the type of wear that was being documented were recorded for each cast.

With the use of digital photography, the photographs were instantly transferred to a computer, where they could be immediately seen and quality and accuracy of the image could be determined. Being able to instantly see the images greatly improved the speed and accuracy of this project. Since the archaeological collection was quite large, a total of 65 artifacts, the amount of photographs taken were quite high and the ability to digitally organize them was extremely helpful.

Due to the high magnification which was used, each photograph would show only a portion of the use-wear in focus. Therefore, each documented location of use-wear would have at minimum two photographs to get the entire portion of use-wear in focus. Through the use of Adobe Photoshop CS6 (64 bit) photo editing software, the individual photos were merged into in-focused photomicrographs. While a time consuming process, these steps were the only way in which an entire image of the use-wear could be seen and recorded.

Methods

Since all of the tools in the archaeological collection have similar overall form and material composition, the usual division of material into the different forms of tools (food procurement, manufacturing, household and ritual and ornamental items (Holland 1992)) is not necessary. The majority of the tools are under the category of flaked or chipped stone tools; however, some portions of the tools, especially those made of sandstone, may have been ground. Tools were grouped by material composition and form to determine if different materials and shapes were used for different functions (See Chapter 2 for tool groupings).

This study uses the same inventory scheme as suggested by Unrath et al (1986) where each tool is divided into different numbered sections to represent and organize locations of examination. In this study, the analyzed locations were coded and divided by 1) proximal, 2) distal and 3) haft (medial), defined as the area encompassing the central hafting location. The location codes also separate the difference between the reverse and obverse sides of the tool. Both the location and side delineations are not based on any particular form or function of the tool, but were put into place to ease the description and recording of the use-wear, tool description, photographs, and mold and casting locations (Figure 11). The casting code set up for this study is as follows:

Code Letter	Location on Tool
A	Obverse Proximal
B	Obverse Distal
C	Obverse Haft
D	Reverse Proximal
E	Reverse Distal
F	Reverse Haft
G	Reverse Tip
H	Obverse Tip

Table 4. Casting codes and locations

Casting Locations and Codes

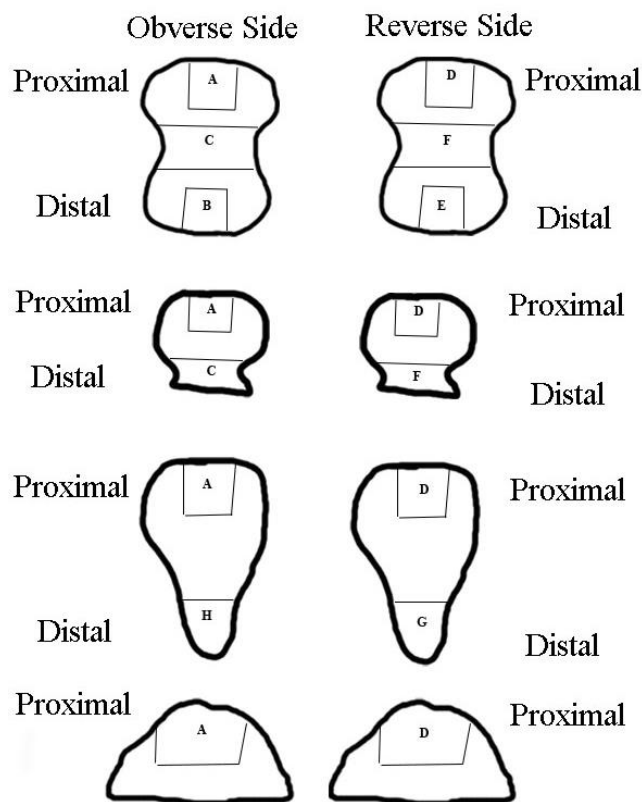


Figure 11. Casting locations and codes

The individual casts were assigned both a letter code associated with its location on the tool and a number code which was a simple numerical count of all of the casts analyzed in this study (Table A-2, A-3, Appendix 1). As each cast was analyzed, the locations where use-wear was found and recorded were then given an additional alphabetic code.

Casting

Microwear analysis of tools can present numerous challenges as it is a procedure which requires specialized microscopic equipment and significant time for observation and analysis. For this study, the main issue was the actual size of the archaeological specimens. Many of the pieces are simply too large to be analyzed underneath a microscope. Casting offers a solution by

allowing the researcher ample time and access to the materials in a collection in a maneuverable form that reflects the attributes of the original artifact (Banks and Kay 2003; Bienenfeld 1995; Plisson 1983). Casting was first used by zooarchaeologists to study surface bone modification (Selvaggio 1994). This method is beneficial for lithic analysis because it easily replicates and documents microscopic use-wear features on lithic surfaces (Igreja 2009).

Banks and Kay (2003) recommend positive casts for microscopic analysis, where the cast reflects the production and use-wear of the tool. Due to the size and shapes of the tools in the Fourche Valley collection, positive casting was necessary since the majority of the specimens were too large, in depth, width and length to easily fit underneath a microscope. Also, high resolution epoxy casts actually increases the visibility of use-wear on non-chert raw materials (Igreja 2009). The procedure for creating high resolution casts in this study shadows the procedure suggested by Banks and Kay (2003) as a way to document use-wear on stone materials. For the entire casting procedure see Appendix 4.

Tool Life Cycle

The process of creating, modifying, using and eventual abandonment of the tool is considered part of its life cycle (Andrefsky, 2009). This cycle can be seen in most archaeological collections especially in the manufacture and discard stages. Schiffer (1972) outlines the tool life cycle process as a linear series of steps: procurement, manufacture, use, maintenance, and discardment. Following Schiffer's criterion, the Fourche Maline collection was analyzed to determine if the cycle of tool creation, use and abandonment can be seen. In addition, delineation of optional maintenance and discard employed the following.

Maintenance of a tool involves secondary modification and consists of re-sharpening, re-shaping, or recycling after the tool has been previously used (Odell 1996). Any damage to or

use of the tool could require maintenance to improve its function and continued utilization. All stone tools require regular upkeep to ensure sharp edges and continual use, especially those used for high impact with hard surface, such as woodworking or soil tilling. Maintenance can also mean heavy modification of a tool after intense damage has occurred and it can no longer function in the original purpose for which it was made. Recycling is defined as a tool which is made “so that if it is broken or not appropriate for the task at hand, it can quickly be brought to a functional state” (Bleed 1986: 739). It is at this point during maintenance where the tool form or shape is changed, possibly dramatically, to acquire further use out of the damaged tool by modifying the form into a new usable figure. Many of the double bitted tools appear to have been modified for use after damage or breakage occurred. Evidence of this can specifically be seen in the categories of single bitted and elongated tools.

If a tool, for whatever reason, cannot be maintained for its original purpose or modified into a new form of tool, it would then be discarded. This is when the tool can no longer function and is the final stage of its life-cycle. At the time of abandonment, the tool form and the context where the tool is discarded may differ greatly from that of its original function (Rots 2010). Numerous tools in the collection represent this stage of the tool life cycle. Many pieces of the archaeological collection were portions of tools damaged beyond any repair or modification for functional use.

Experimental Replication

As part of this study, an experimental collection was created to compare to the archaeological collection to assist in determining the original use of these tools (Figure 12 and Table 5; Appendix 3 for Scott County Experimental Collection). In use-wear analysis, experimental replication “provide[s] a link between the static facts (macro- and microscopic

wear traces) observed on archaeological tools today and past dynamics (production, use and hafting)” (Binford 1977; 25). Experimental usage serves as a comparative template and is the first step to any systematic archaeological use-wear study (Binford 1977; Keeley 1974, 1980; Rots 2010).

Keeley (1974) defines the main goal and general purpose of use-wear analysis is to reconstruct the economic activities of a people. “This assumption implies two general conditions of a good microwear study: first, it must attempt to obtain precise designations of function for the implements examined, and secondly it must attempt to obtain as complete a picture as possible of the total uses represented on implements from the archaeological unit under investigation” (Keeley, 1974; 1).

Three factors need to be covered in order for an experimental collection to be significant, stating “it is very important that the experimental framework be relevant (a) to the ecological situation and other general conditions of the site or sites from which the study materials originate, (b) to the likely worked materials (soil, wood, bone and so on), and (c) to the material types from which the archaeological implements are made” (Keeley 1980; 5). All three criteria are met by this study.

Scott County Experimental	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Hafting Width (mm)	Tip width (mm)	Style	Mat
1	694.9	1780	101.68	28.7	56.35	n/a	Double	SSS
2	90	100.7	42.92	21.5	n/a	22.94	Elongated	SSS
3	173.7	110.83	81.42	23.5	n/a	31.53	Single	SSS
4	29.4	56.2	49.92	13.5	n/a	11.63	Single	SSS
5	40.7	63.56	50.91	16	n/a	13.94	Single	SSS
6	145.3	98.76	68.75	18.2	48.53	n/a	Double	chert
7	258.8	122.15	74.32	22.7	55.97	n/a	Double	SSS
8	154.9	88.59	57.72	21.4	41.59	n/a	Double	SSS
9	44.4	58.63	52.4	17.8	n/a	18.88	Single	SSS
10	303.9	112.72	81.26	30.1	54.53	n/a	Double	SSS
11	106.5	100.66	64.67	23.1	n/a	28.02	Single	SSS
12	136	129.95	53.67	28.2	n/a	15.42	Single	SSS
13	81.1	80.15	47.52	21	32.4	n/a	Double	SSS
14	73.4	69.32	42.15	21.4	n/a	n/a	Elongated	SSS
15	74.8	80.53	49.92	19.3	n/a	n/a	Elongated	SSS
16	85.5	70.02	49.66	19.9	40.72	n/a	Double	SSS
17	70.3	97.26	47.89	12.9	34.28	n/a	Double	SSS
18	46.9	71.27	45.29	14.1	38	n/a	Double	SSS
19	174.2	94.67	60.69	24.8	50.07	n/a	Double	SSS
20	110.2	82.8	64.09	28.9	n/a	21.34	Single	SSS

Table 5. Scott County Experimental Replica Collection

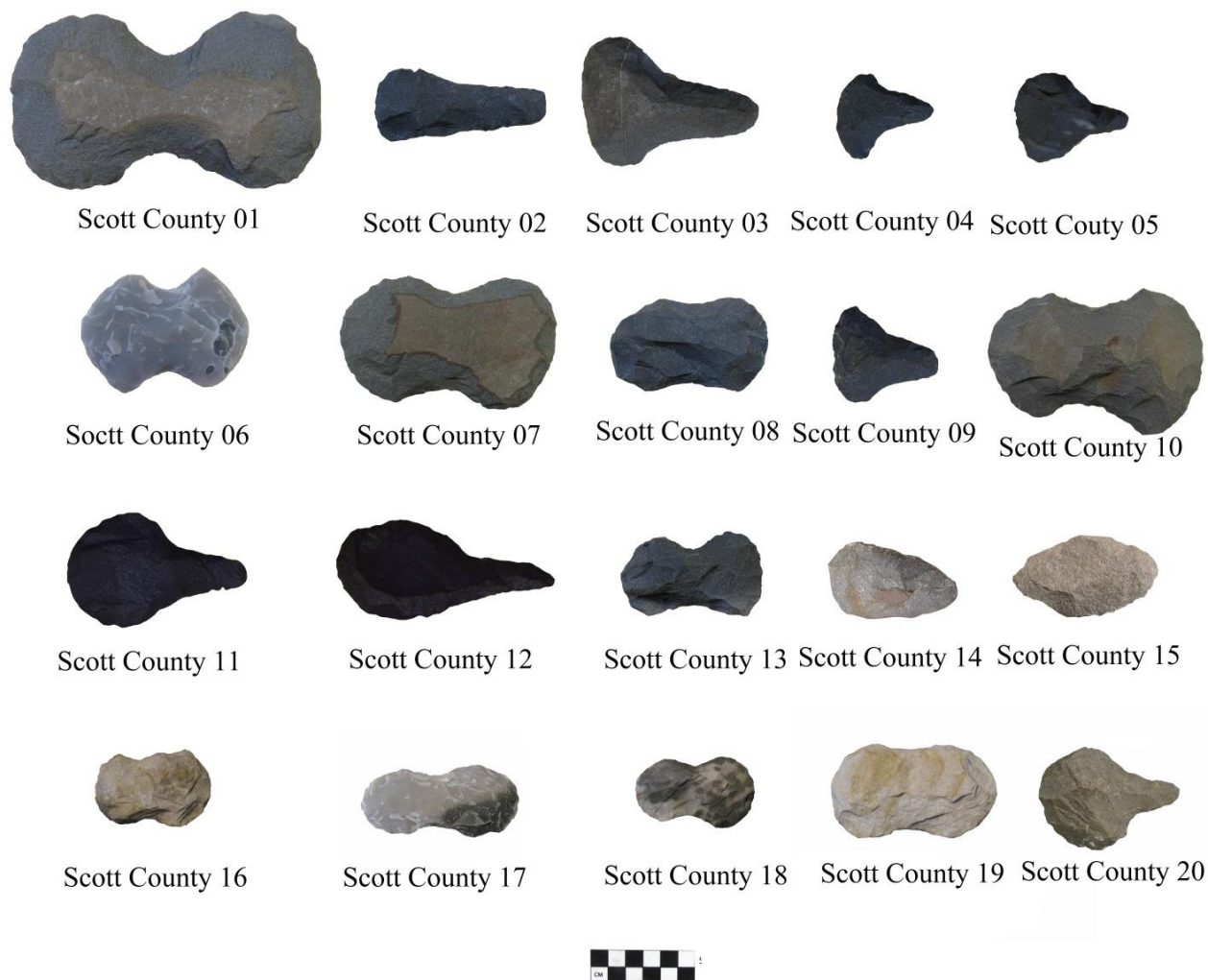


Figure 12. The entire Scott County Experimental Collection.

The site location, in the Ouachita Mountains is about 80 miles from Fayetteville, Arkansas, which is the location of the author. The environmental setting is virtually the same. Both locations encompass the same ecological system of an oak-hickory-pine forest with similar soil types and moisture conditions. Experimentation addressed soils and forest from the Fayetteville, Arkansas region.

The experimental collection of 20 tool replicas knapped and hafted in different ways and with varying types of material. The three main tool forms, double bitted, single bitted and elongated, were recreated for the experimental work (Table 6 and 7). The experimental collection was created by Mike Evans and Jared Pebworth of the Arkansas Archaeological Survey. They collected the material February 27, 2013 in Scott County Arkansas, along the Fourche La Fave River, southwest of the Fourche Valley site and the possible outcrop where the material was originally obtained by the Fourche Maline people. The Scott County experimental collection consisted of replicas of silicified sandstone, chert and sandstone, all of which are represented in the archaeological collection. The silicified sandstone replicas were created using direct percussion with hammerstones (Figure 13).

With any experimental work, it is necessary to combine numerous uses with a variety of material as well as multiple experiments performed for each of these uses and material categories (Keely 1980). The experimental work considered woodworking (tree felling, bark removal), agricultural uses (ground surface hoeing, removal of small shrubbery), and tool use on animal bone (breaking of large long bones for marrow removal).

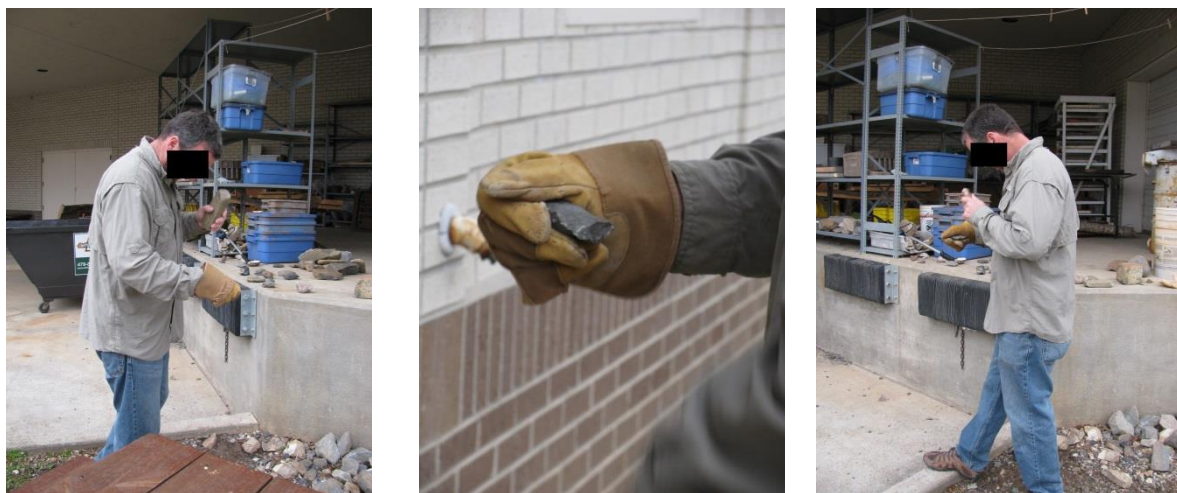


Figure 13. Production of the Scott County experimental collection.

	Double Bitted	Single Bitted	Bifacial
Silicified Sandstone	SC 01	SC 03	SC 02
	SC 07	SC 04	SC 14
	SC 08	SC 05	SC 15
	SC 10	SC 09	
	SC 13	SC 11	
	SC 18	SC 12	
		SC 20	
Sandstone	SC 16		
	SC 19		
Chert	SC 06		
	SC 17		

Table 6. Scott County experimental collection form and material categories

	Double Bitted	Single Bitted	Elongated
Woodworking	SC 08	SC 03	SC 14
	SC 13	SC 04	
	SC 17	SC 09	
	SC 19	SC 11	
		SC 12	
		SC 20	
Agricultural use	SC 01		SC 02
	SC 06		
	SC 07		
	SC 10		
Marrow extraction	SC 18		
Damaged in Production	SC 16	SC 05	SC 15

Table 7. Uses of Scott County Experimental Collection by tool form.

Manufacture and usage of the experimental collections assisted in showing the Fourche Maline tool life cycle from creation to abandonment, and the role stone material played in tool use. It also highlights similarities within the Fourche Valley site groups, especially the practice piece/toy grouping being composed of mostly sandstone.

The replica forms created for the experimental collection is consistent with the major tool forms seen in the archaeological collection – the single bitted, double bitted and elongated tool forms (Figures 14-16).

The double bitted category contains the largest number of tools in the experimental collection and is comprised of tools made of silicified sandstone, sandstone and chert (Figure 14). A total of ten tool replicas were made, the largest of which is Scott County 01 which has a mass of 694.9 grams, with a length of 1780 mm, a maximum width of 101.7 mm and a thickness of 28.7 mm. The smallest of the double bitted tools in the experimental collection is Scott County 18 which weighs 46.9 mm, and is 71.3 mm in length, a maximum width of 45.29 mm and a thickness of 14.1 mm.

The single bitted experimental collection of eight tools is composed of silicified sandstone (Figure 15). They consists of a variety of sizes, with the largest of the group being Scott County 03, which has a mass of 173.7 grams, with a length at 110.8 mm, a maximum width of 81.4 mm and a thickness of 23.5 mm. The smallest of the tools in this grouping is Scott County 04 which has a mass of 29.4 grams, a length of 56.2 mm, a width of 49.9 mm and a thickness of 13.5 mm.

The smallest portion of the experimental collection replicated the elongated category. This group consists of a total of three tools, all composed of silicified sandstone (Figure 16). These three tools are fairly comparable in size; the largest is Scott County 02, with a mass of 90

grams, a length of 100.7 mm, a maximum width of 42.9 mm and the thickness of 21.5 mm. The smallest of the tools in this grouping is Scott County 14, with a mass of 73.4 grams, a length of 69.3 mm, a maximum width of 42.2 mm and the thickness of 21.4 mm.

The entire collection was first documented and photographed. Prior to hafting, it was coated with MethalVoilet (Figure 17), a photographic processing chemical to dye the tools a dark purple. This staining wears away through use, making the location of potential use-wear easily seen. The tools made of silicified sandstone absorbed the MethalVoilet more, while the chert tools were significantly lighter in color.

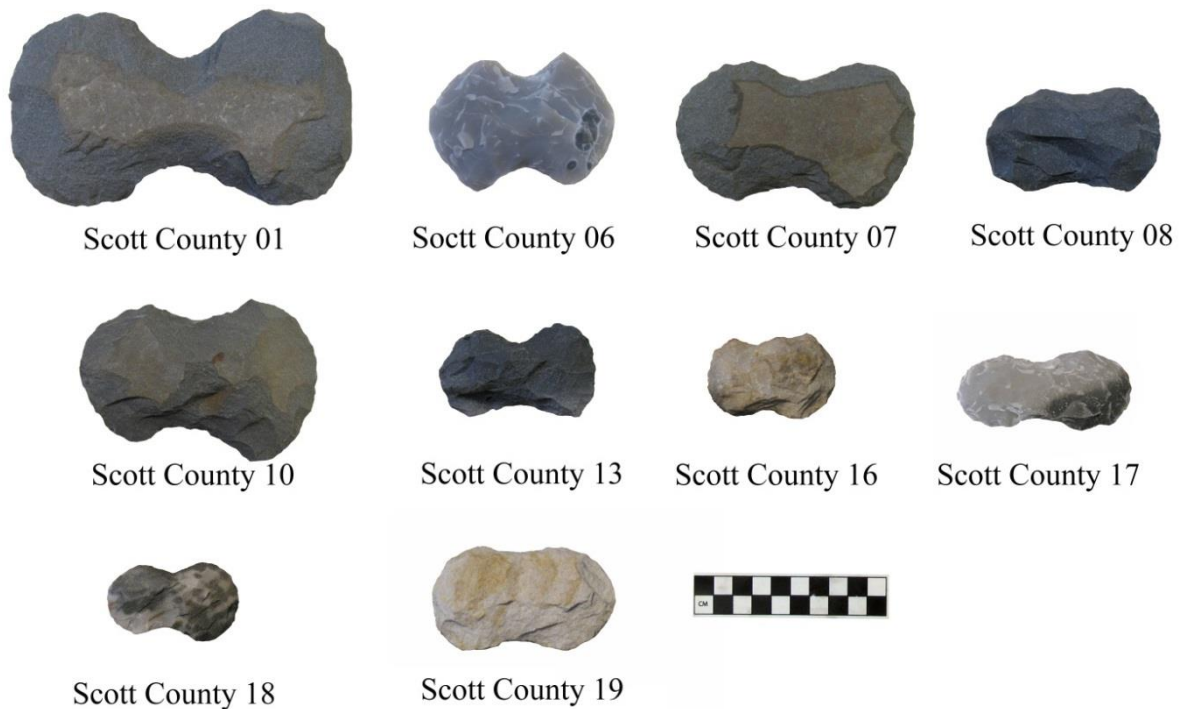


Figure 14. The double bitted tools of the Scott County Experimental Collection.



Figure 15. The single bitted tools of the Scott County Experimental Collection.



Figure 16. The elongated tools of the Scott County Experimental Collection.

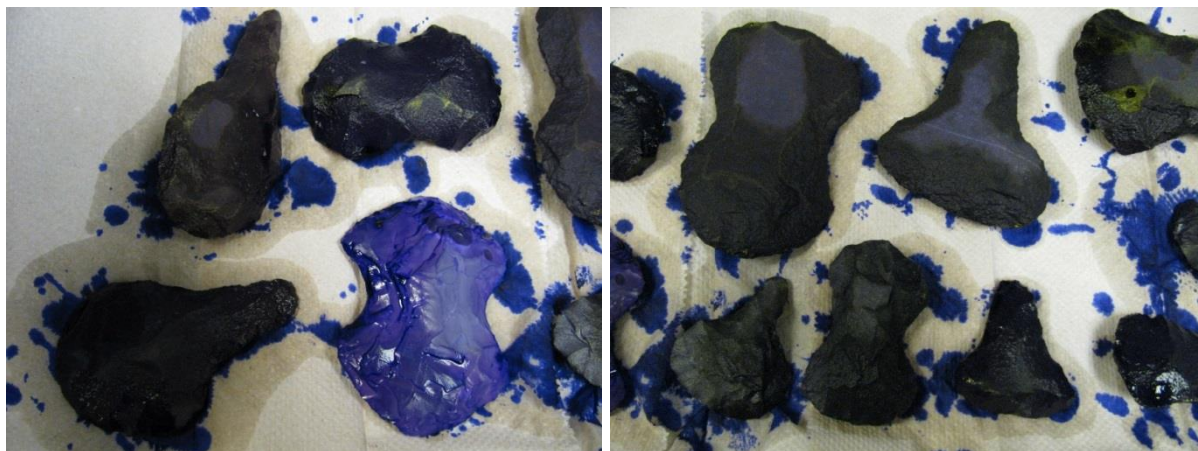


Figure 17. Scott County Experimental collection after the MethalVoilet processing.



Figure 18. Experimental replica hafting styles

Woodworking and agricultural replica tool hafting employed different handle types, materials (rawhide, willow bark, cedar), and attachment (punch form with no hafting material, use of wedges). Replica hafting was based on similar tools found in bluff shelters in Arkansas, common hafting forms for other axes and agricultural hoes found at prehistoric sites or whatever forms kept the replica in place while in use (Figure 18). Handles of hickory, pine, oak, and cedar were created using a mix of modern power tools and old woodworking tools (Figure 19). Handles varied for the different tool forms and to see which had the greatest success.

Hafting material consisted of cedar and willow bark, sinew, leather, rawhide, cordage, and modern waxed string. The bark was removed in strips, then soaked in water for at least two days to make it malleable and able to wrap around the tools and the handles (Figure 20). Once the bark was supple enough for use, the outer bark was scraped off leaving the soft inner bark. The inner bark was wrapped around a tool and the edges tucked back under itself. The bark must be fully dry before tool use, as it tightened as it dried, creating a better hold on the tool. Sinew, leather, or raw hide were treated similarly, but the drying time was of even greater importance. Cordage and modern wax string were easiest to use since they could be used as is, or employed whenever a tool's original hafting failed.

Double bitted hoe tool hafting includes attachment to a long corner notched branch usually bent closer to a 90 degree angle, to aid in the agricultural process by allowing the tool to hit the ground at a specific angle. The hoes were hafted on both the top and bottom of the supportive branches to see if this attachment would change use and polish and to see if this had any bearing on the strength or weakness of either the tools or the handles. The double bitted axe tools were hafted in numerous different ways to determine which worked best and to see if different hafting approaches left different wear traces. The axe handles consisted of the tools



Figure 19. Handle production for the Scott County experimental collection. Images taken by Jared Pebworth and Rachel Campbell at the Arkansas Archaeological Survey on March 14th 2013.

wedged between two small portions of wood in the center of the handle, to thinned pieces of soaked wood wrapped around the tool. All double bitted axe tools had additional hafting materials to secure the tool to the handle.

All single bitted tool replicas were hafted as axes as this form is not conducive for agricultural use. The majority of the tools were hafted in a punch form hafting, where the tool is simply jammed into a hollowed out portion of the handle. No hafting material was used or



Figure 20. Bark processing for hafting of the Scott County experimental collection. Images taken by Jared Pebworth at the Arkansas Archaeological Survey in March 14th 2013.

needed. The simple action of impacting this tool form against a hard surface caused the tool to become wedged further into the handle, creating a greater bond between the stone and the wood. Some of these tools were modified in the field with hafting material needed to reduce shifting of the tool within the handle.

Both elongated tool replicas were used in punch hafting, where the tool was jammed into a hollowed out portion of the tool handle. One was designed as an adze for agricultural purposes, the other an axe for woodworking. Neither of these tools had any hafting material originally; however, modifications were made in the field to increase stability of the tools.

If the experimental collection was used successfully on material as that in prehistory, the evidence should be seen microscopically (Keeley 1974, Semenov 1964, Wilmsen 1968, and Gould et al. 1971). The Scott County experimental collection was used on varying types of material at three different site locations over the course of six days. Site locations varied from wooded country property located 25 miles outside of Fayetteville, AR to two wooded housing locations in Fayetteville, AR. All three experimental locations are both wooded and not maintained as well as having either overgrown gardens, heavily grassed lawns or prairie like conditions to perform the work. The collection was used by 9 male and female volunteers, ranging in age from undergraduate college students to retired adults and varying in sizes, strengths and handedness.

IV. Results

The experimental replicas were essential for the analysis of the archaeological collection, because they allow for comparison of known, experimental use-wear with that of unknown, use-wear of the archaeological. This chapter discusses errors which occurred throughout this project and the wear on the experimental and the archaeological collections. The descriptions of wear for both collections are broken down by the groupings described in Chapter 2. For the complete images of the use- wear for both collections, see Appendix 2 and 3.

Errors

Research on the double bitted tools came with a share of setbacks and errors. Dealing with a large collection, a delicate casting procedure and an experimental collection there are bound to be some errors which are unavoidable. This section discusses those errors and ways in which they were avoided or reduced.

Collection errors

The collection raised interesting questions about damage which occurs after abandonment and what that means for the use-wear on these tools. Many of the tools, especially those in the practice piece/ toy category, have post-deposition damage, most likely from modern agriculture, seen in the presence of large scarring and roughly broken edges. While these tools have both additive and abrasive use-wear present, there is concern that this wear could be the result of the movement of the tools through the soil during plowing activities.

Silicified sandstone is susceptible to pseudo-wear in the form of conchoidal fractures which can be seen on both the archaeological and experimental collections and are likely created during the production of the tool (Figure 21). This type of pseudo-wear can be distinguished from actual wear, but it can cause delays in observation. Conchoidal fractures appear to be

reduced or eliminated with continued use where it is replaced or worn away by additive or abrasive wear. Some tools in the archaeological collection still have the presence of these conchoidal fractures perhaps implying tool use may have been limited prior to abandonment.

Casting errors

The casting process has the greatest potential for error and did occur during the process as described in Appendix 4. The buildup of oils or grease from handling can be seen on the casts and while the tools were cleaned, the presence of oils shows not all residues were removed (Figure 22). Air bubbles in the cast occur when the epoxy is not poured smoothly into a mold or if the ratio of chemicals is not mixed correctly (Figure 23). One of the major disadvantages of the casting procedure is there is no way to modify a cast if errors occur and the process then has to be restarted. However, through the steps described in Appendix 4, the majority of casting errors can be eliminated or at least reduced to minimal impact.

Experimental errors

The experimental collection is a vital part of this study. However, there are numerous potential ways which the experimental replicas could be used, hafted, handled or knapped. To help counter this, the replicas were used in multiple ways to cover potential uses.

The actual use of the experimental collection adds its own challenges to the research. None of the volunteers who participated in the experimental work are stone tool experts so error could have occurred simply through use. Three experimental tools were damaged early in production and three additional tools were damaged during use. These errors are likely due to the researcher not knowing the proper way to utilize the tool and this lack of knowledge can cause wear which may not have occurred in the past.

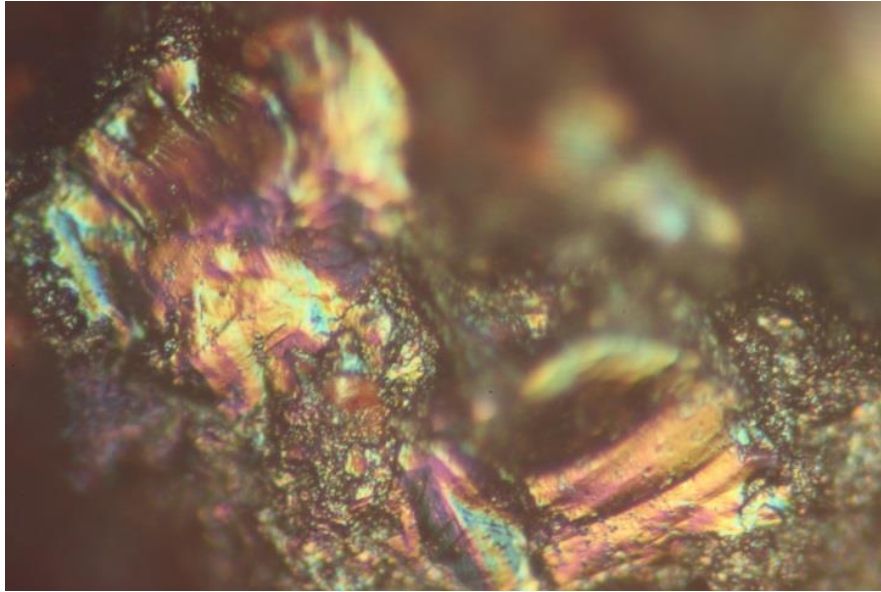


Figure 21. Pseudo-wear in the form of conchoidal fractures

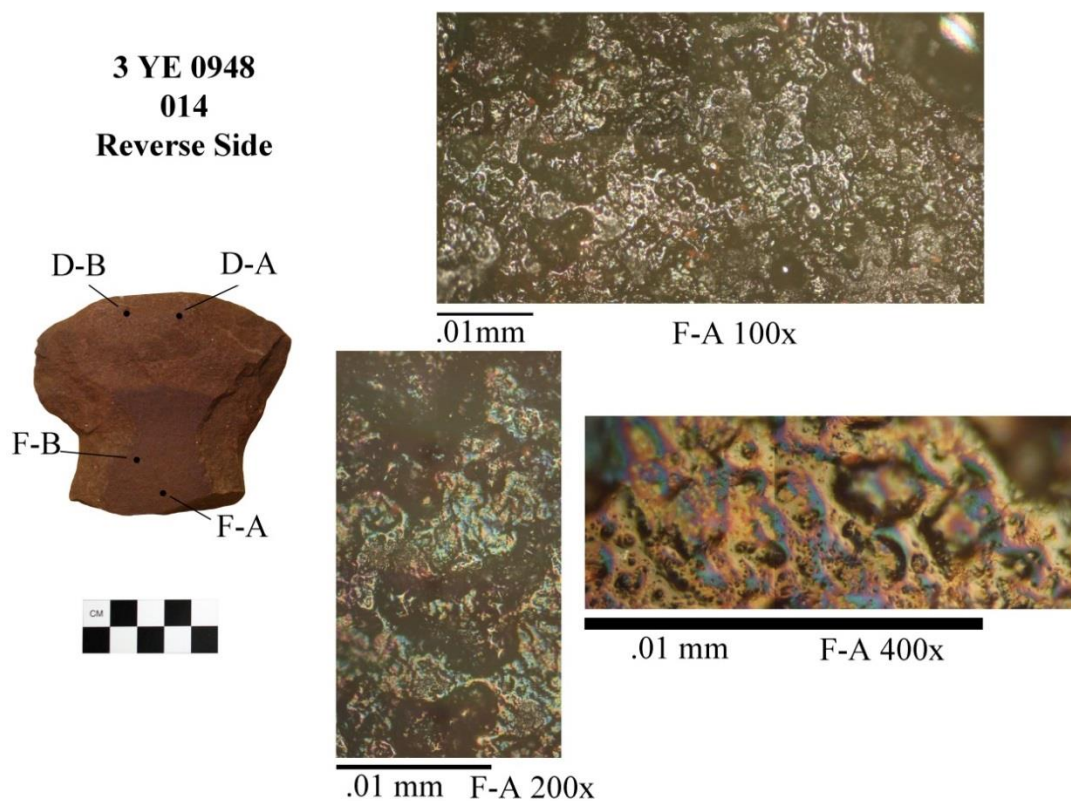


Figure 22. Casting error in the form of oil or grease on Artifact 014.

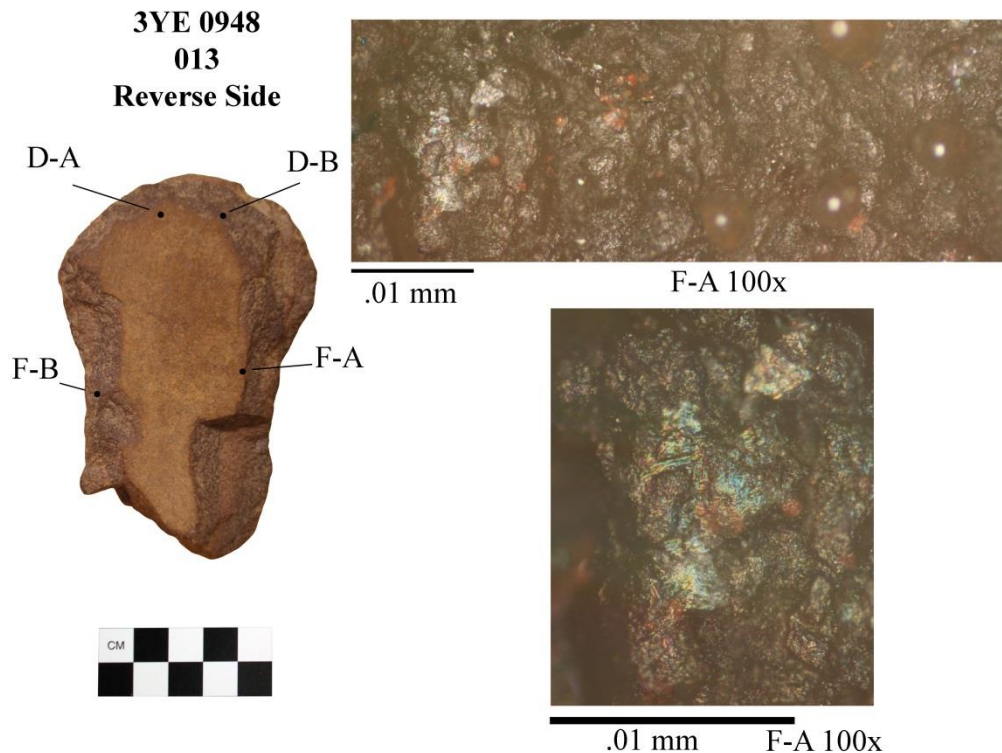


Figure 23. Air bubble casting error on Artifact 013, Location F-A 100x.

Types of Wear

Every tool in the archaeological collection had microscopic use-wear. The wear tends to follow a pattern of abrasive then additive with some showing an additional period of abrasive wear. The first stage of wear is light abrasive grinding, followed by microplating (Figure 24), the buildup of silica gel from impact with organic material. Silica gel develops on the tool in layers and when it hardens, it actually binds to the stone. The longer the silicified sandstone is used, the larger the locations of microplating. Continued use of a tool, sees more abrasive wear occurring on top of the additive microplating wear, in the form of smoothing and striations (Figure 25). This linear pattern is virtually the same for both the bit and haft locations (Figure 26).

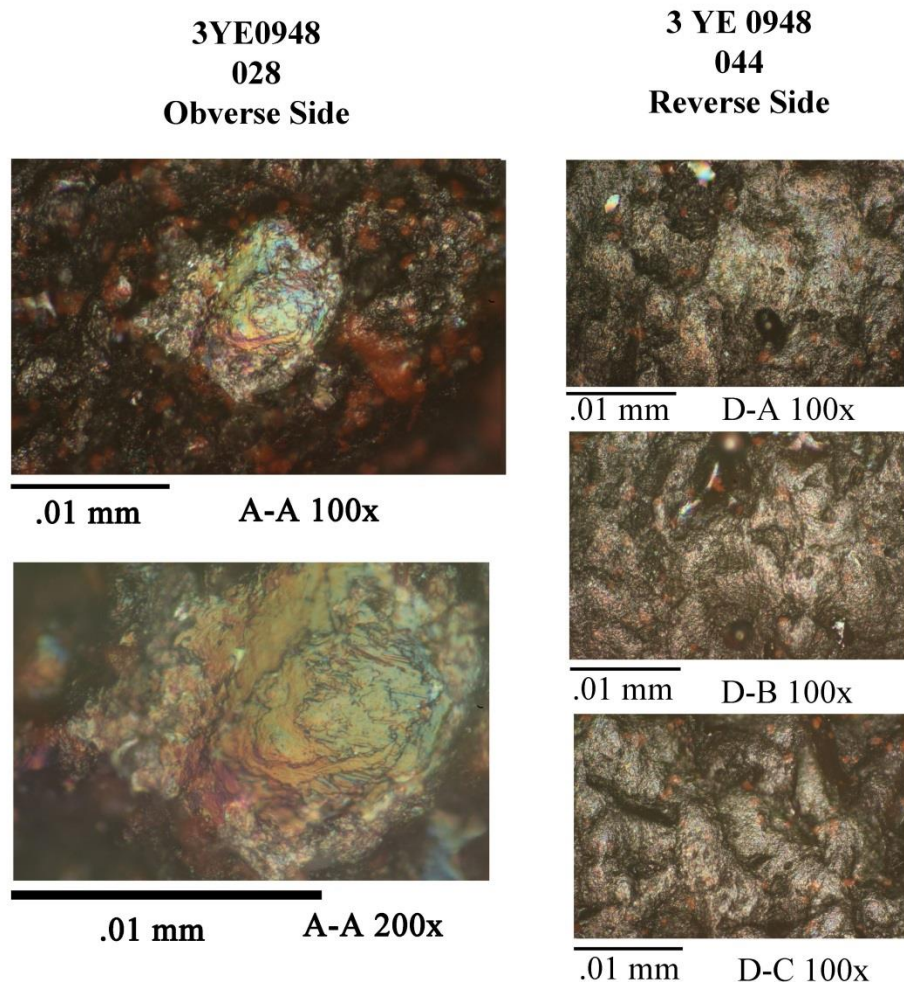


Figure 24. Common microplating and generalized abrasive wear seen on the Fourche Valley site archaeological collection. Artifact 028, Location A-A shows microplating additive wear. Silica gel from organic material builds up from use to create a layering effect which hardens and binds to stone. Artifact 044, Locations D-A, D-B and D-C, show heavy generalized abrasive wear.

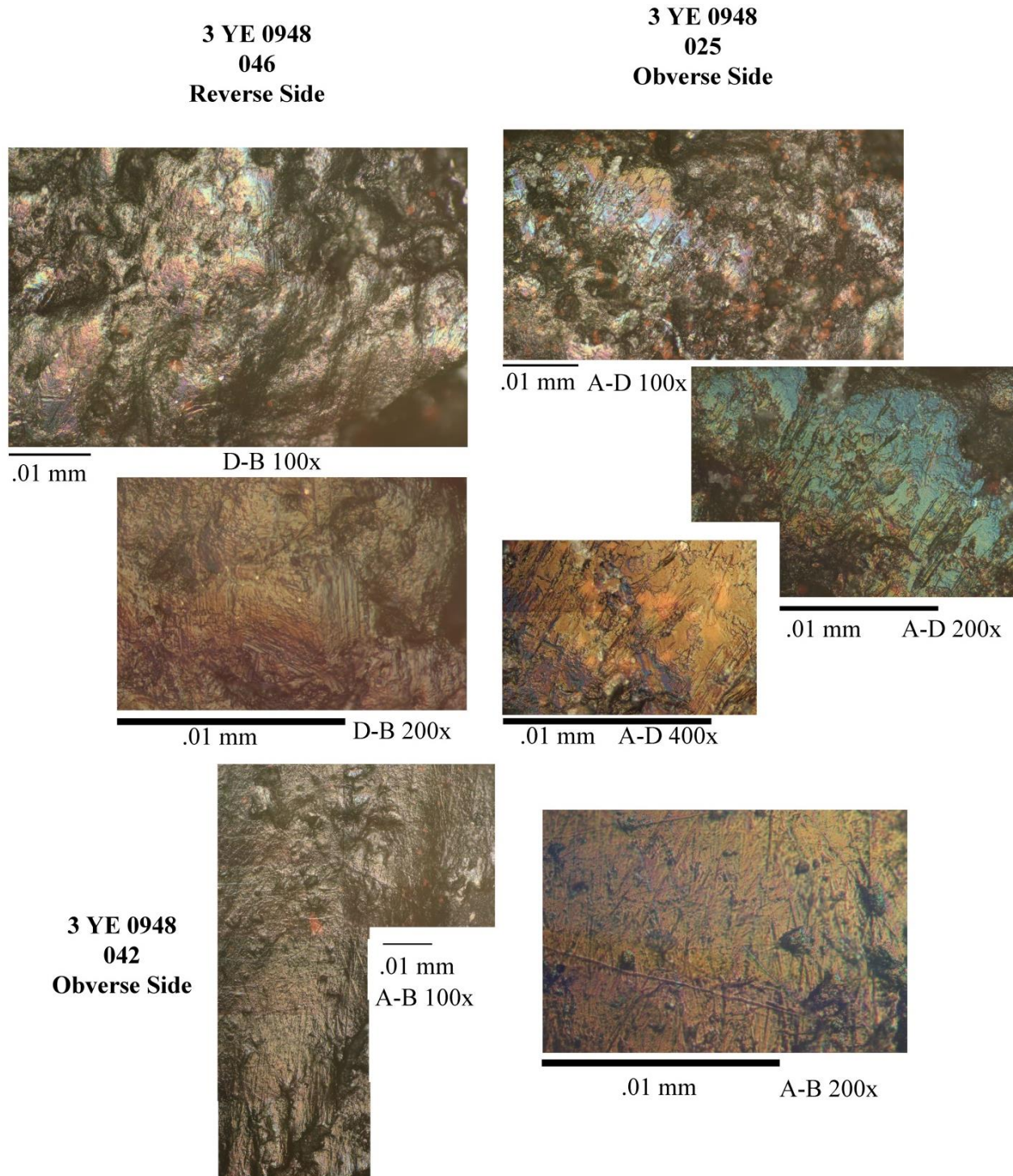
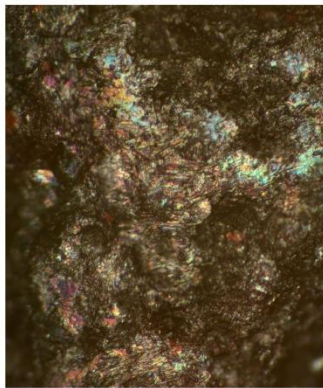
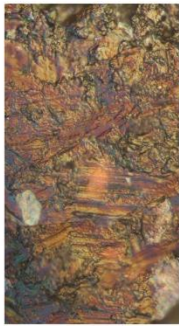


Figure 25. Common additive and abrasive wear seen on the Fourche Valley site archaeological collection. Artifact 046, Location D-B, shows large planes of microplating wear with light abrasive striations present. Artifact 025, Location A-D, shows the next step in the wear patterns, where the microplating begins to be abraded down and creates large flat planes on which numerous abrasive striations can be seen. Artifact 042, Location A-B, shows the further abrasion of the microplating wear with numerous striations.

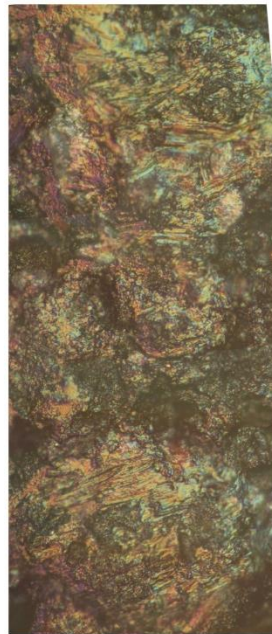
**3 YE 0948
009
Reverse Side**



.01 mm F-B 100x

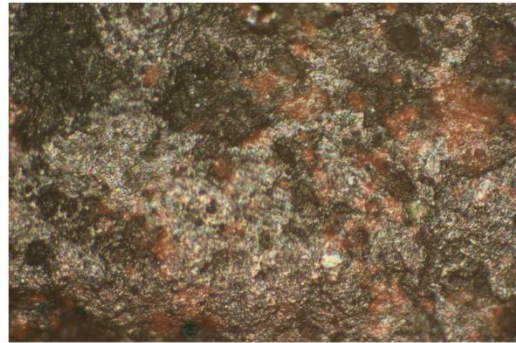


.01 mm F-B 400x

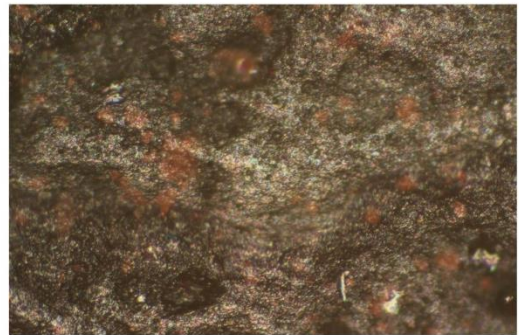


.01 mm F-B 200x

**3 YE 0948
048
Obverse Side**



.01 mm C-A 100x



.01 mm C-B 100x

Figure 26. Common hafting wear seen on the Fourche Valley site archaeological collection. Artifact 009, Location F-B, shows light generalized abrasive wear with heavy microplating additive wear and directional abrasive striations from particles trapped in the hafting material. Artifact 048, Locations C-A and C-B show heavy abrasive wear without any additive wear.

Wear on both the experimental replicas and archaeological tools fall along a continuum of wear. The differences in wear patterns while slight are visible along this continuum. These tools are utilitarian in nature and therefore it is not a stretch to assume they were multi-functional in the past. Some of these tools were likely used as only woodworking tools, some as only agricultural with a wealth of variation along this range.

Experimental Collection Results

Scott County experimental collection use-wear is quite telling as to the potential purpose of the double bitted stone tools. Since the material used in the experimental groupings is from the same region as the archaeological collection, it can be assumed that the experimental tool results are instructive. For the double bitted, single bitted and elongated replicas, this chapter looks at the purpose (woodworking, agriculture, marrow extraction) for which each of these forms were utilized (Table 10). For the complete use description for each tool, see Appendix 3.

In general, the experimental woodworking tools have portions of abrasion or smoothing located near the bit edge. Striations are present on some of the tools, but are lesser in number, than on the archaeological collection. Microplating can be seen, but tends to be small and in discrete locations. Hafting wear appears with limited striations, but usually with significant abrasion, most likely due to continuous and significant movement of the tool within the hafting.

The experimental agricultural replicas have significantly more striations present on the bit edges than the experimental woodworking tools, likely due to heavy impact with rocks and other debris within the soil. While abrasion is present, it tends to be larger than what is seen on the experimental woodworking tools. Additive microplating wear is significantly larger than on the woodworking tools with plane-like additive locations and portions of heavy striations. The entire experimental collection shows heavy pseudo wear, mostly conical fractures found throughout the tools' surface.

Hafting wear on the experimental tools is similar in spite of differences in hafting forms and material used. During use the experimental collection shifted within the handles, no matter the handle form or hafting material used. Due to this movement, the tools in the experimental

collection tend to have very similar hafting wear. For the experimental collection, hafting wear is discussed separately from the bit wear due to the variation in hafting and handle construction.

Experimental Woodworking Tools

The experimental woodworking consist of 11 replicas, four double bitted, six single bitted and one elongated. In general, the single bitted forms worked better as axes, as they stayed in the handles longer. Many of the double bitted experimental tools shifted in the hafting, usually cutting through the hafting material, rendering the tool useless for all experimental use- wear see Appendix 3.

	Double Bitted	Single Bitted	Elongated
Wood working	SC 08	SC 03	SC 14
	SC 13	SC 04	
	SC 17	SC 09	
	SC 19	SC 11	
		SC 12	
		SC 20	
Argicultural use	SC 01		SC 02
	SC 06		
	SC 07		
	SC 10		
Marrow extraction	SC 18		
Damaged in Production	SC 16	SC 05	SC 15

Table 10. Listing of the Scott County experimental tool based on tool use and form.

Double Bitted Scott County Woodworking Tools

Four experimental double bitted replicas were used for woodworking, Scott County 08, 13, 17, and 19. Unfortunately, these experimental replicas do not have much use-wear present, most likely due to numerous problems with hafting during the actual experimental work.

The microscopic wear on Scott County 13 shows abrasion on the distal bit end (Figure 27). Used as an axe on multiple occasions, this replica functions both for the removal of bark and attempted felling of trees. Wear runs slightly oblique to the bit edge and consists of abrasion with no evidence of striations.

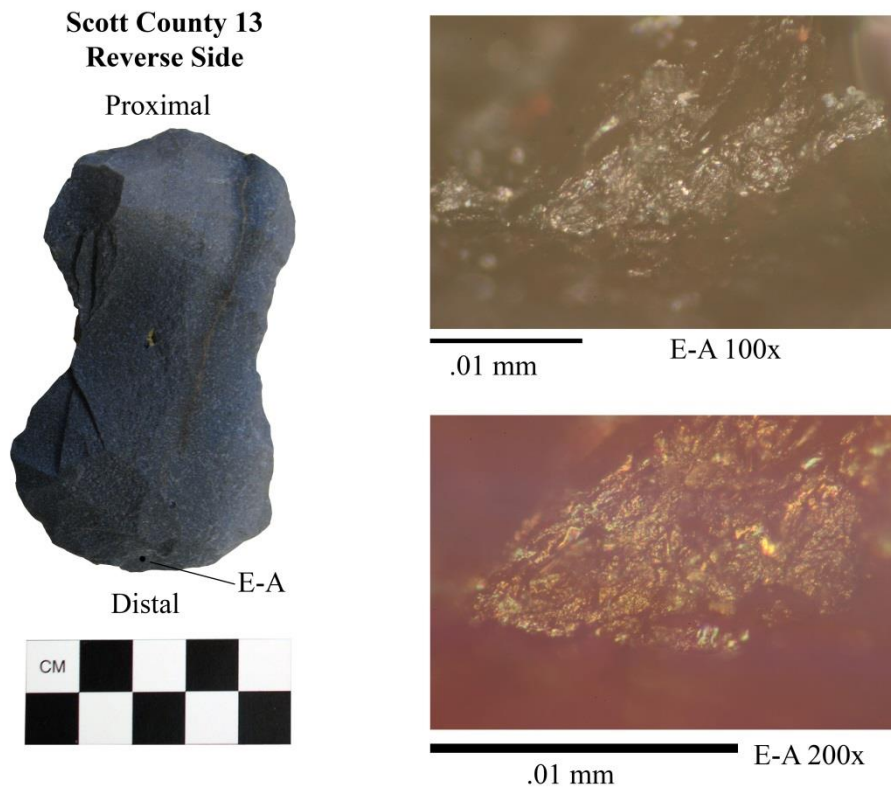


Figure 27. Experimental bit edge woodworking use-wear on Scott County 13, Location E-A, showing generalized abrasion.

Single Bitted Scott County Woodworking Tools

All of the single bitted replicas for the Scott County experimental collection were used as woodworking tool since the shapes were not conducive to use as an agricultural implement. Use-wear on these tools shows additive and abrasive wear with limited numbers of striations (Figures 28-32). These tools also have significant pseudo-wear, mostly in the form of conchoidal fractures, which cover the majority of the tool's surface.

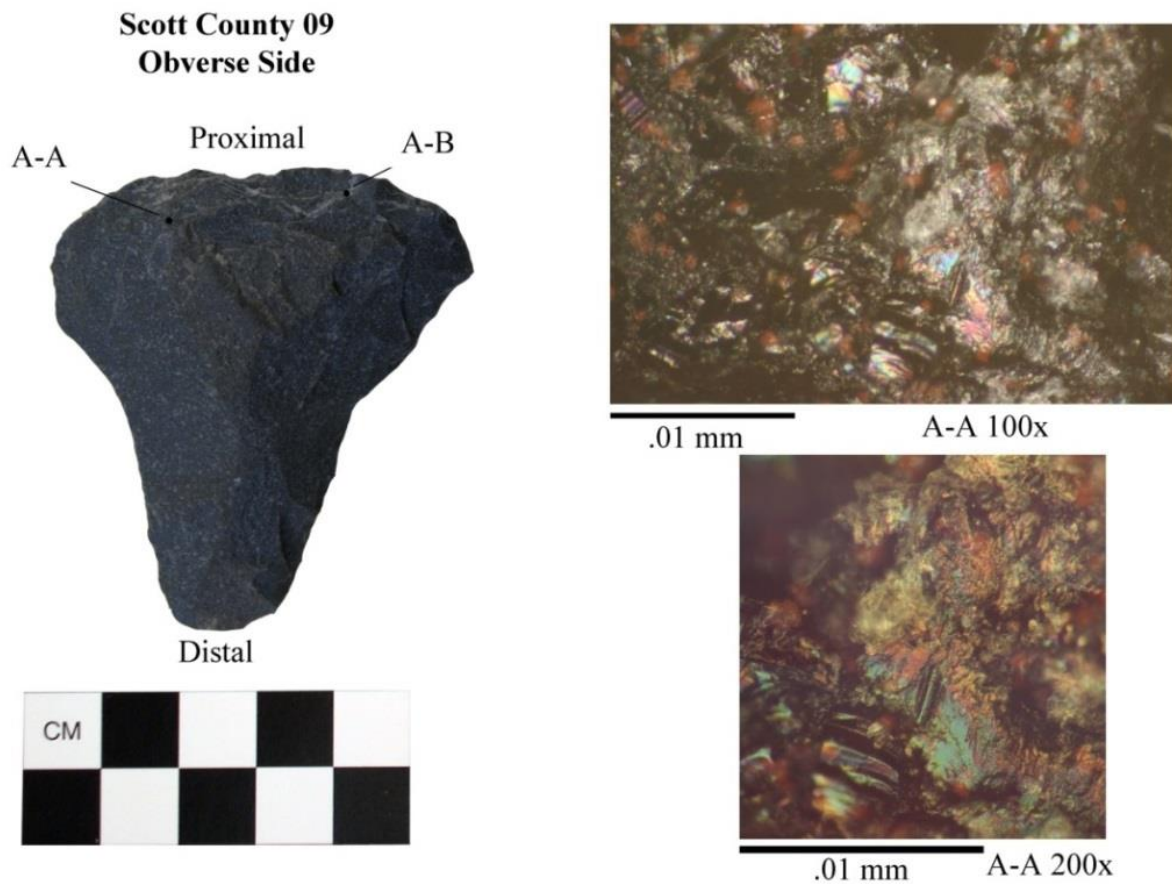


Figure 28. Experimental woodworking use-wear on Scott County 09, Location A-A, the obverse proximal edge, showing generalized abrasion and numerous conchoidal fractures.

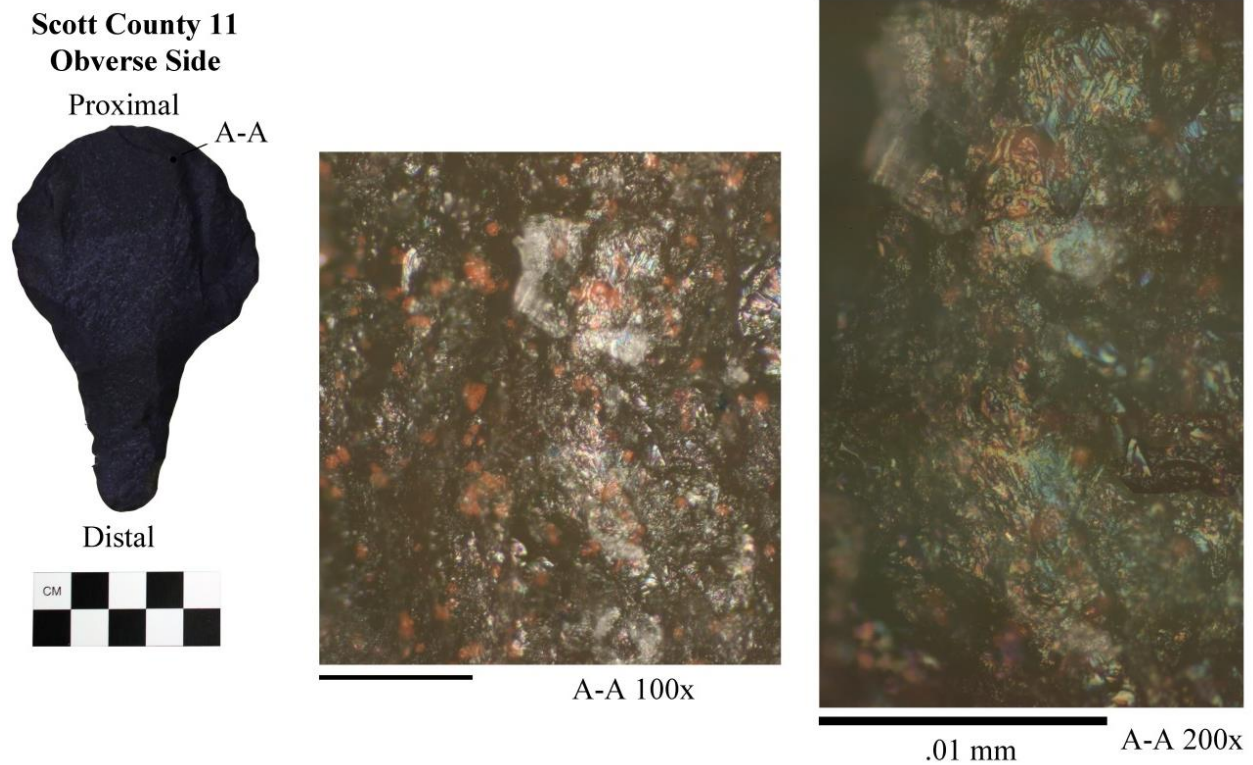
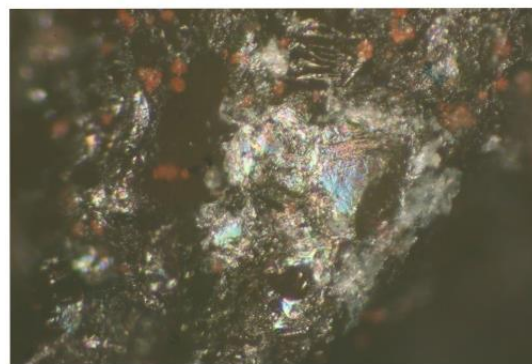
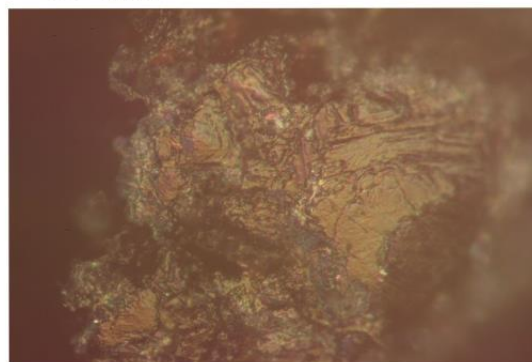


Figure 29. Experimental woodworking use-wear on Scott County 11, Location A-A, the obverse proximal edge, showing generalized abrasive and additive wear. Evidence of microplating slightly filled in striations and crystalized filaments, can be seen. Wear is multidirectional, but mostly obliquely perpendicular to the bit edge.



.01 mm

A-B 100x



.01 mm

A-B 200x

Figure 30. Experimental woodworking use-wear on Scott County 11, Location A-B, the obverse proximal edge, showing generalized abrasive and additive wear. This location shows evidence of microplating, seen in the addition of harden silica gel, crystalized filaments, and striations.

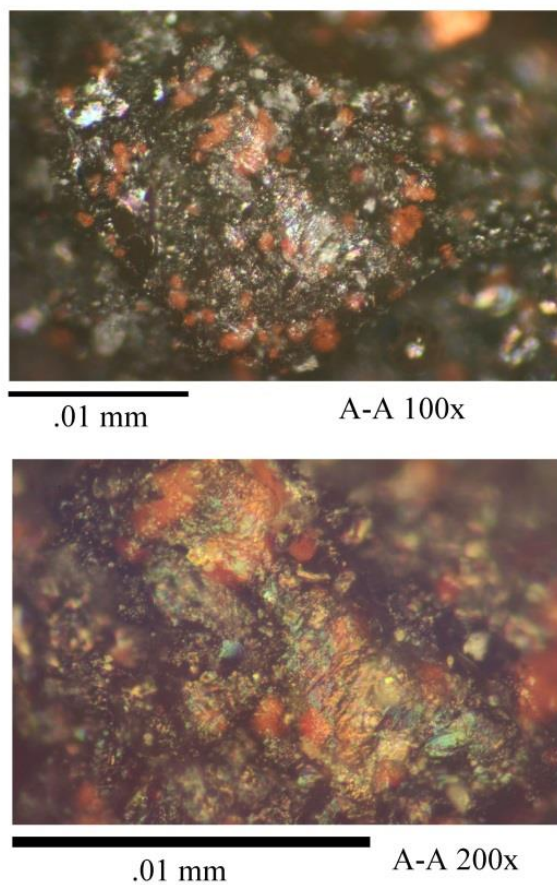


Figure 31. Experimental woodworking use-wear on Scott County 014, Location A-A, showing generalized additive and abrasive wear. Microplating and light obliquely angled striations can be seen.

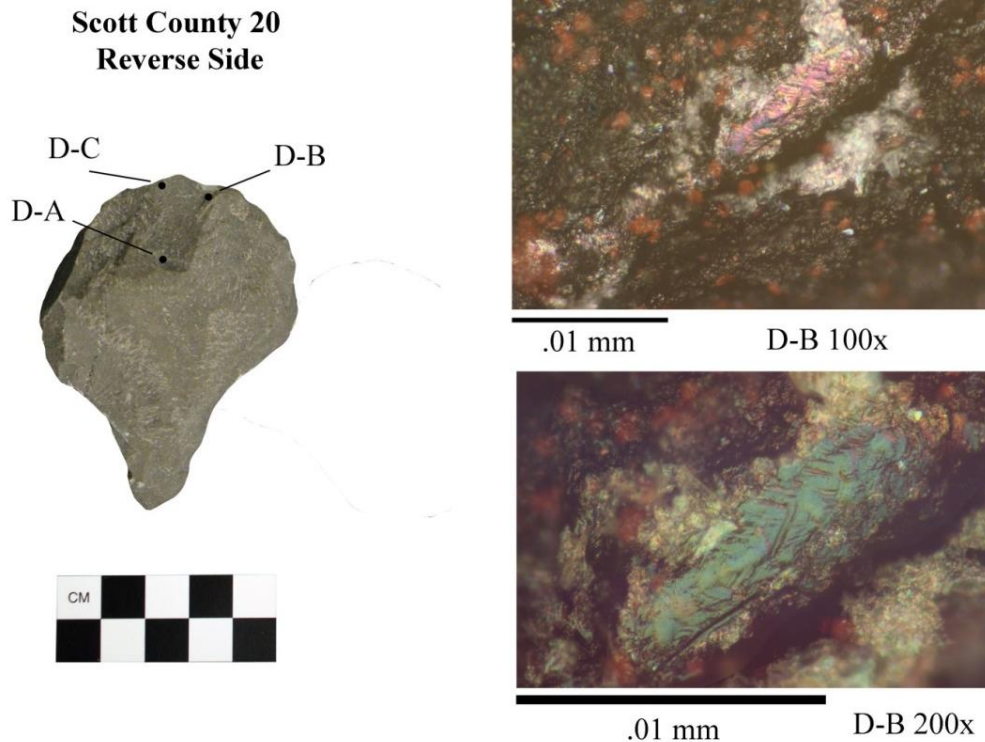


Figure 32. Experimental woodworking use-wear on Scott County 20, Location D-B, the reverse proximal edge, showing generalized additive and abrasive wear and light oblique striations to bit edge.

Experimental Agricultural Tools

The experimental agricultural replicas have heavy additive wear with later abrasion and striations. Four Scott County experimental double bitted tools were used as agricultural tools, Scott County 01, 06, 07, and 10 and one elongated tool, Scott County 02. Microscopic wear on the bit edges of these tools are similar throughout the experimental collection and are a representative sample of wear which occurs when tools are used to till rough vegetation and rocky soil (Figures 33-37).

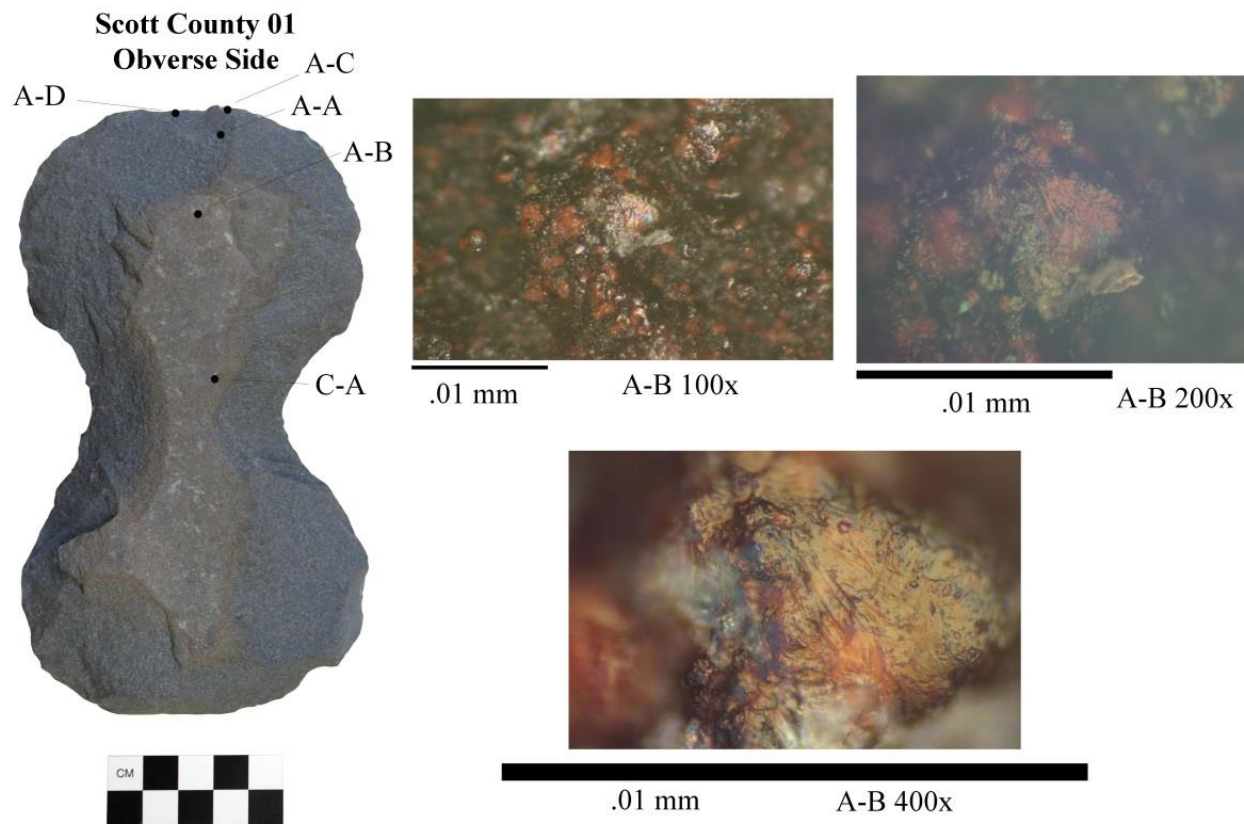


Figure 33. Experimental agricultural use-wear on Scott County 01, Location A-B, the obverse proximal side. This location shows microplating, crystalized filaments, filled in striations and other abrasions cutting through the harden silica gel.

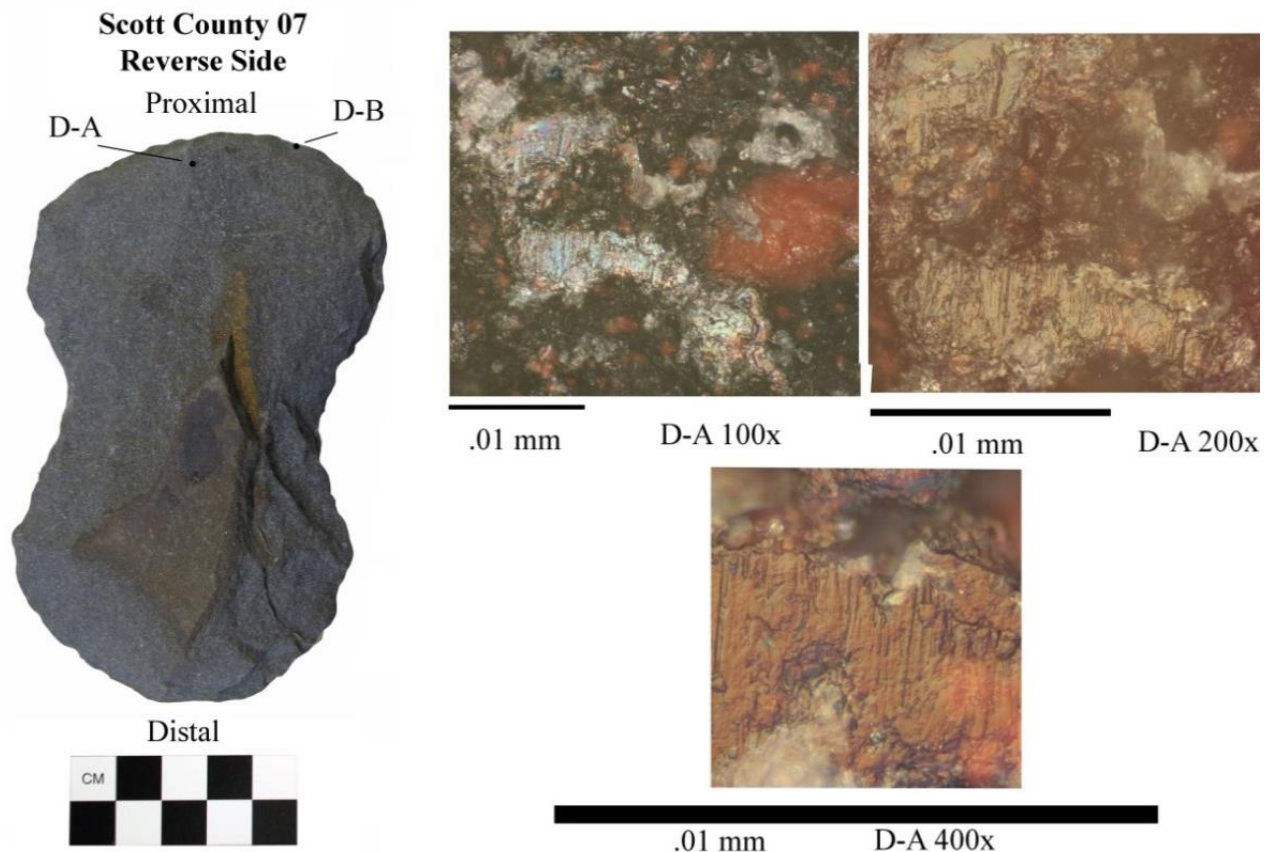


Figure 34. Experimental agricultural use-wear on the reverse proximal edge, Location D-A, of Scott County 07. Microscopic wear on the bit edges of Scott County 07 shows heavy striations from use. The D-A location on the reverse proximal edge shows large plane microplating with heavy striations. Numerous deep striations can be seen at this location and are most likely due to the impact of the tool with rocks and other materials found within the soil.

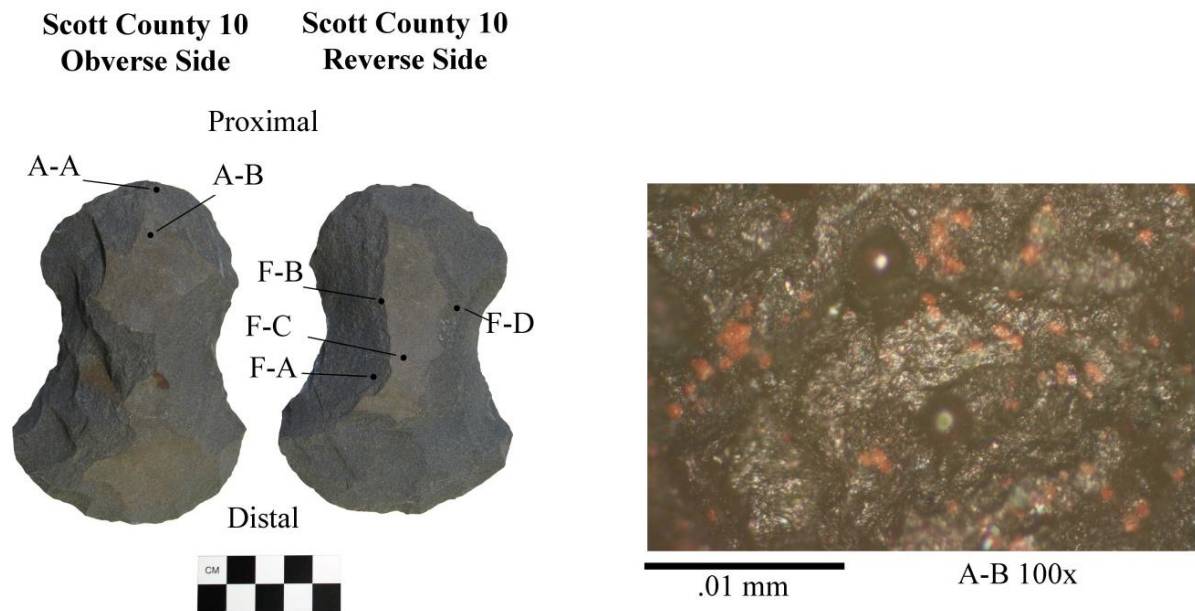


Figure 35. Experimental agricultural use-wear on the obverse proximal edge, Location A-B, of Scott County 10, showing generalized abrasion and the beginnings of microplating wear.

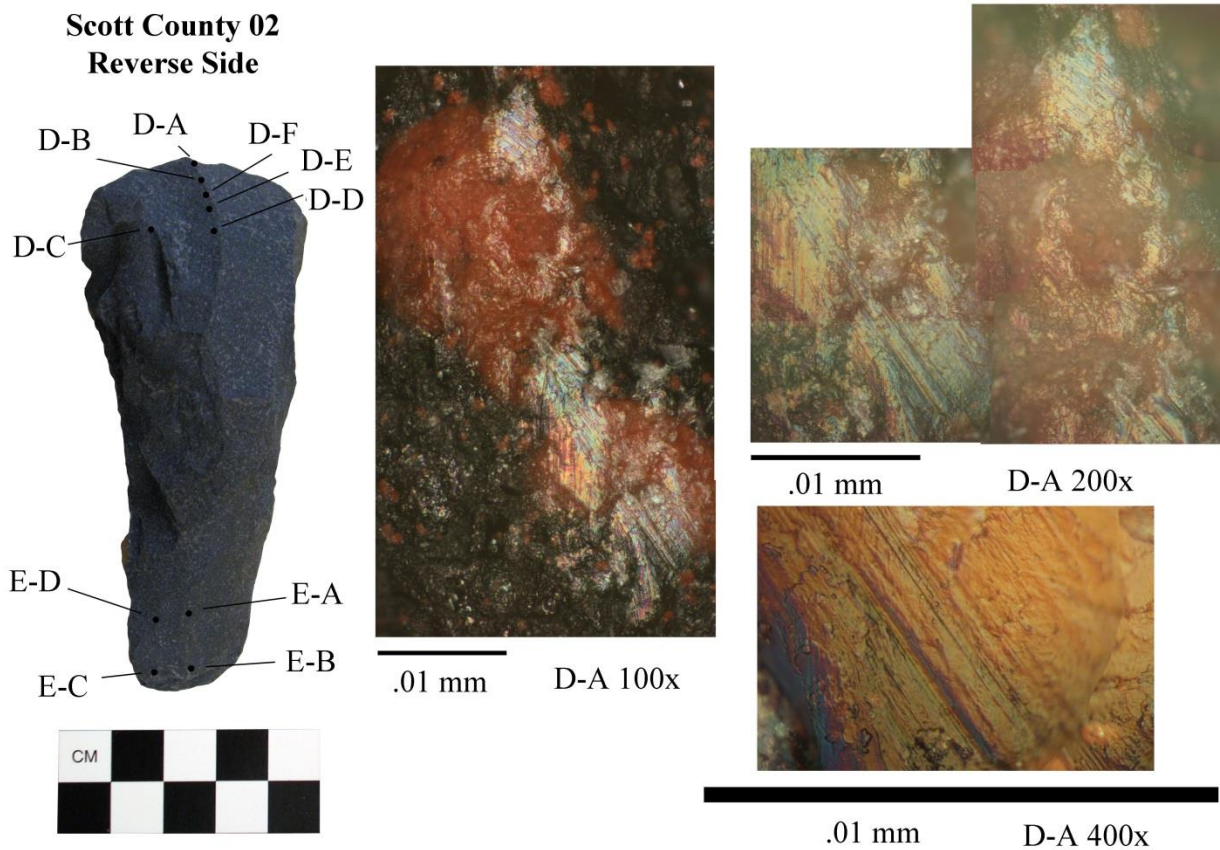


Figure 36. Experimental agricultural use-wear on Scott County 02, Location D-A, the reverse proximal side, showing large additive wear with heavy obliquely angled striations.

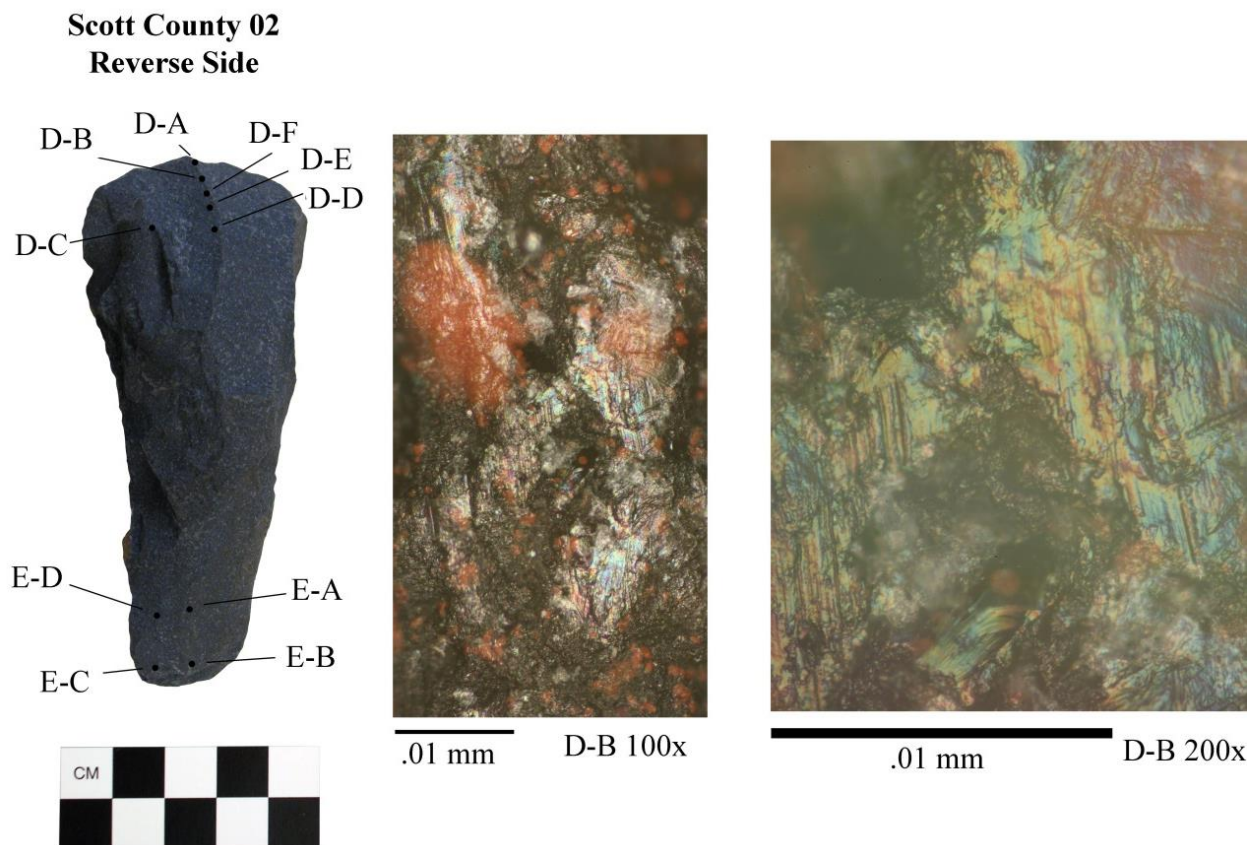


Figure 37. Experimental agricultural use-wear on Scott County 02, Location D-B, reverse proximal side, showing heavy abraded additive planes, with overlapping striations, microplating with filled in striations and crystalized filaments.

Animal Processing Experimental Tools

For this study, I added animal lone bone processing for marrow extraction to the potential uses of these tools. This function was never really thought to be how these tools were used, but was added to the experimental framework to cover additional types of wear. The experimental work supported the original hypothesis; these tools are terrible at animal bone processing. Scott County 18 was used for this process on the long bones of a cow. During experimentation extensive damage occurred to the replica. Large flakes broke off during impact quickly rendering the tool edge useless. The use-wear on Scott County 18 shows significant difference in wear with a directional scraping of the stone occurring (Figures 38 and 39).

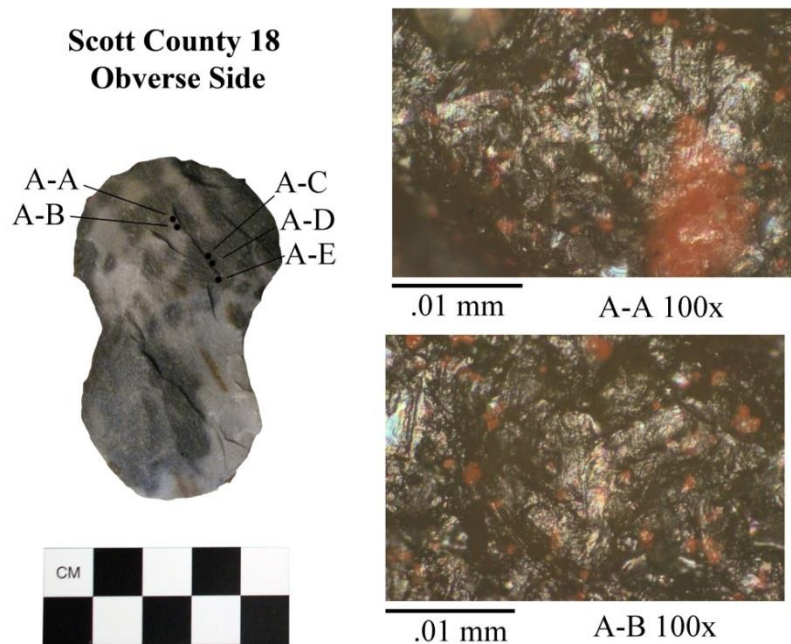


Figure 38. Experimental animal processing use-wear on the obverse side of Scott County 18, Locations A-A and A-B, showing directional scraping wear.

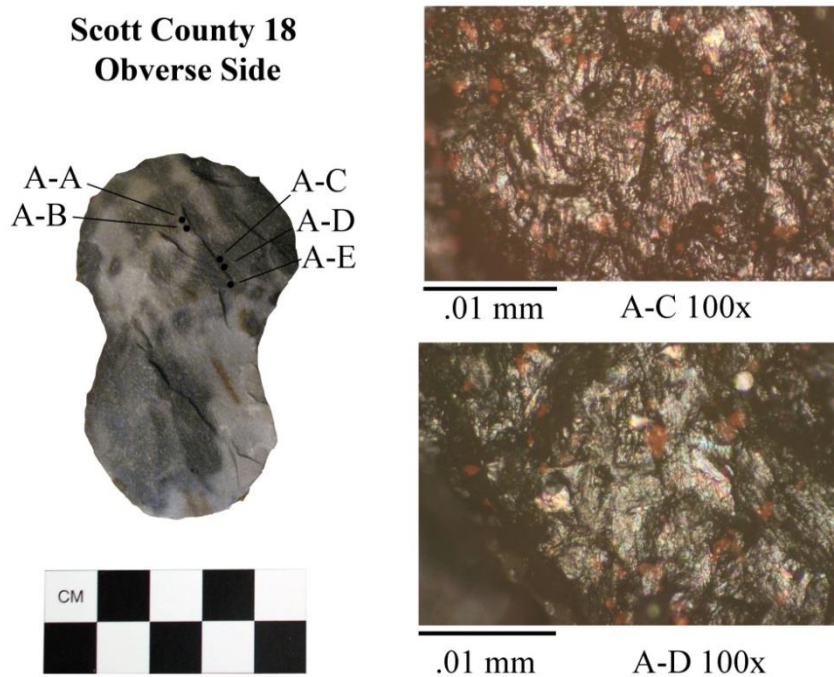


Figure 39. Experimental animal processing use-wear on the obverse side of Scott County 18, Locations A-C and A-D, showing directional scraping wear.

Experimental Hafting

The hafting for the experimental tools utilized multiple forms and methods to recreate wear seen on the archaeological collection. The hafting wear is described based on the form of hafting - axe, punch, agricultural hoe, or adze hafting. If the hafting form utilized binding material, the type is highlighted. See Chapter 3 and Appendix 3 for description of all hafting forms.

Axe Form Punch Hafting

Hafting seen on the punch hafted tools is abrasive in nature with no striations present. Wear is fairly light and is likely caused from the tool shifting within the tool handle or from original tool placement (Figure 40 and 41).

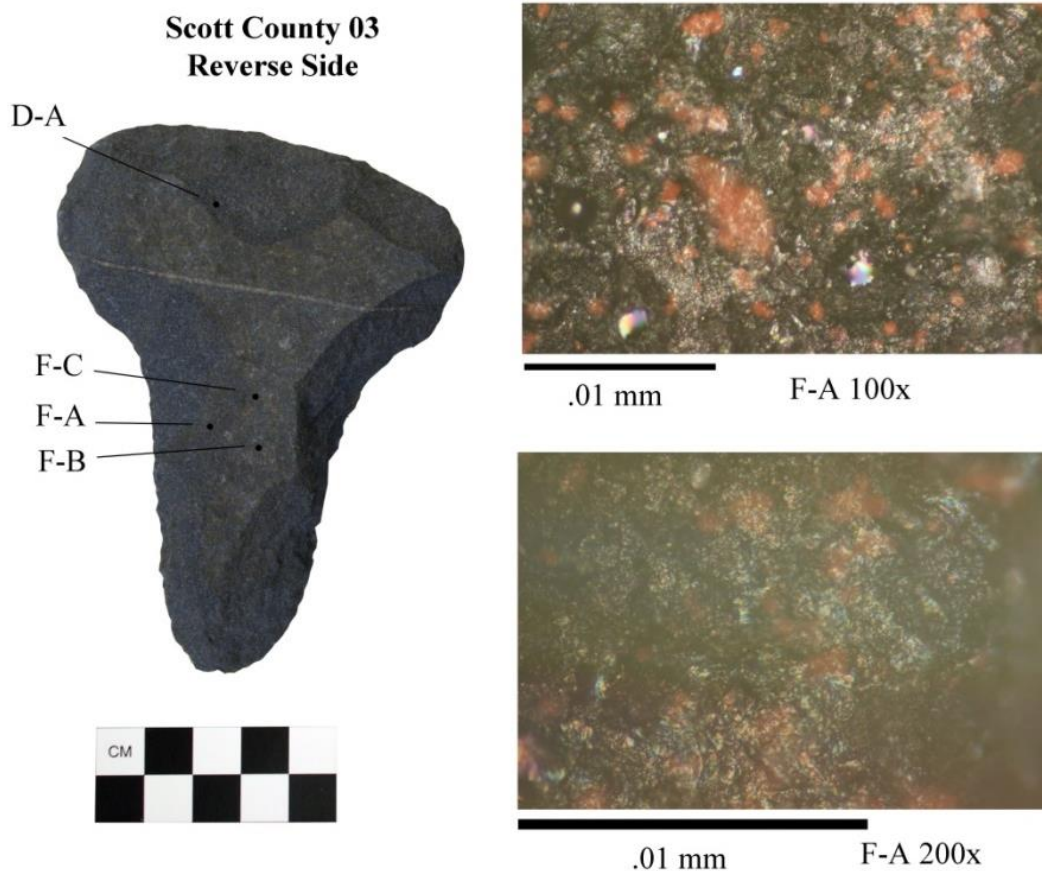


Figure 40. Experimental hafting wear in the punch form hafting on Scott County 03, Location F-A, reverse hafting side, showing generalized abrasion.

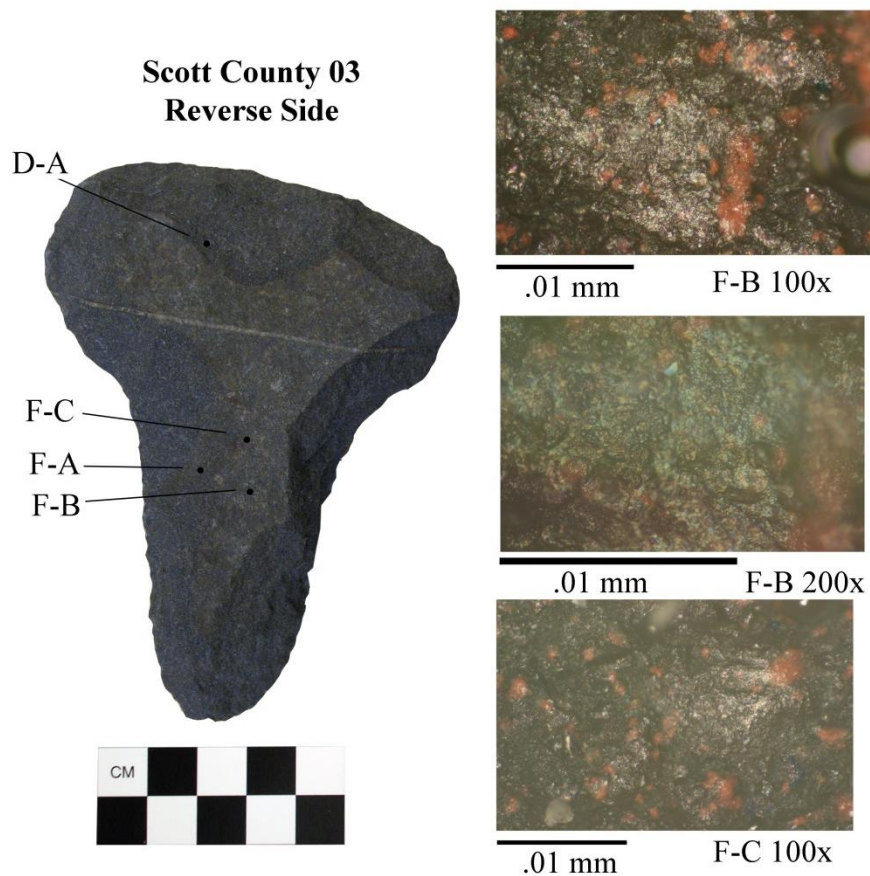


Figure 41. Experimental hafting wear in the punch form hafting Scott County 03, Locations F-B and F-C, reverse hafting side, showing general abrasion.

Agricultural Hoe Punch Form Hafting

Scott County 02 is the only experimental tool hafted as an adze. Hafting wear consists of both additive and abrasive wear with a few striations (Figure 42). Wear is from tool movement within the wooden handle. Light evidence of microplating can be seen with filled in striations and crystalized filaments. Striation wear runs perpendicular to the bit edge and there is some evidence of overlap.

Agricultural Hoe Hafting

Experimental hafting for agricultural hoe replicas consist of large generalized abrasion. There is no obvious difference in wear from hafting material, although greater use of the

experimental collection likely would change this outcome. Hafting wear on Scott County 01, 07 and 10 shows generalized abrasion with slight directionality running perpendicular to the bit edge (Figures 43-45).

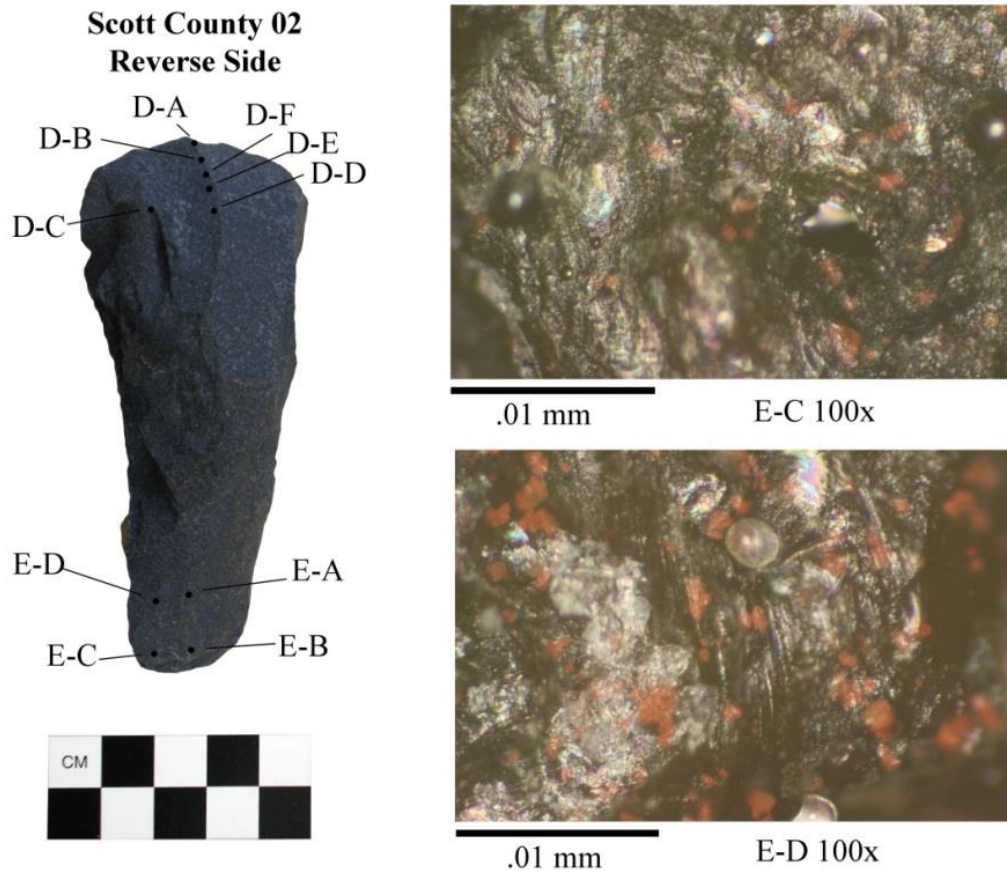


Figure 42. Experimental hafting wear in the punch form hafting on Scott County 02, Locations E-C and E-D, showing generalized abrasion, light striation wear, microplating and filled in striations.

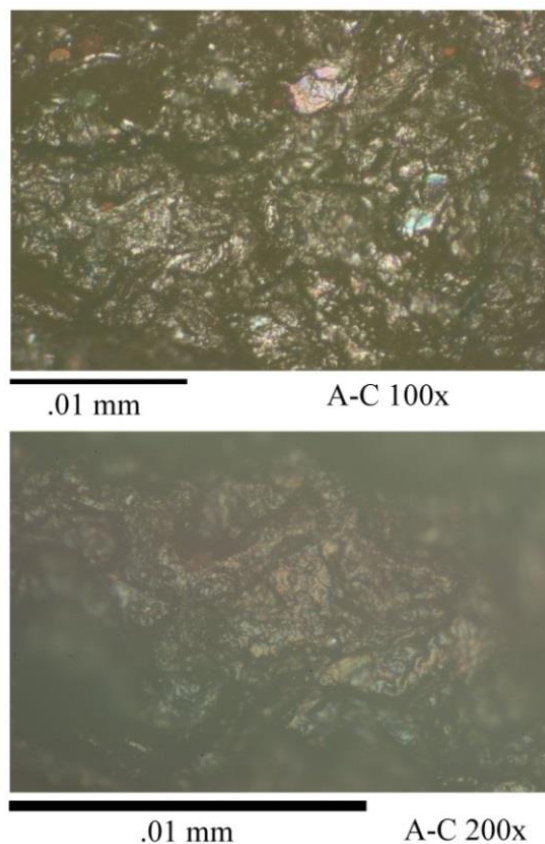
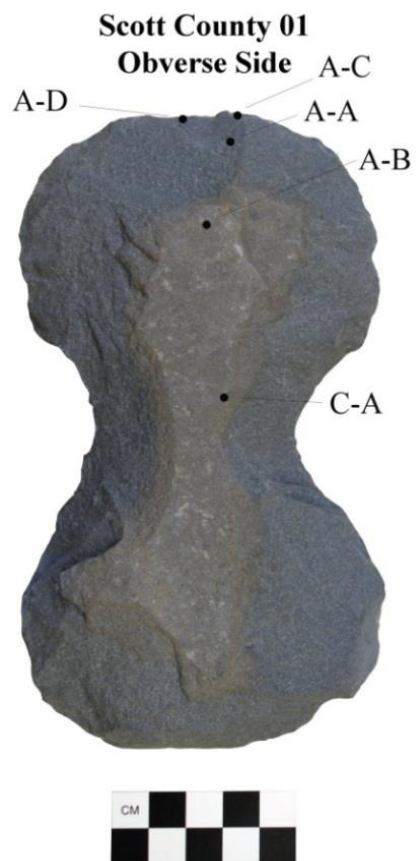


Figure 43. Experimental hafting wear on Scott County 01, Location A-C, showing generalized abrasive wear. Willow bark was utilized as the hafting material.

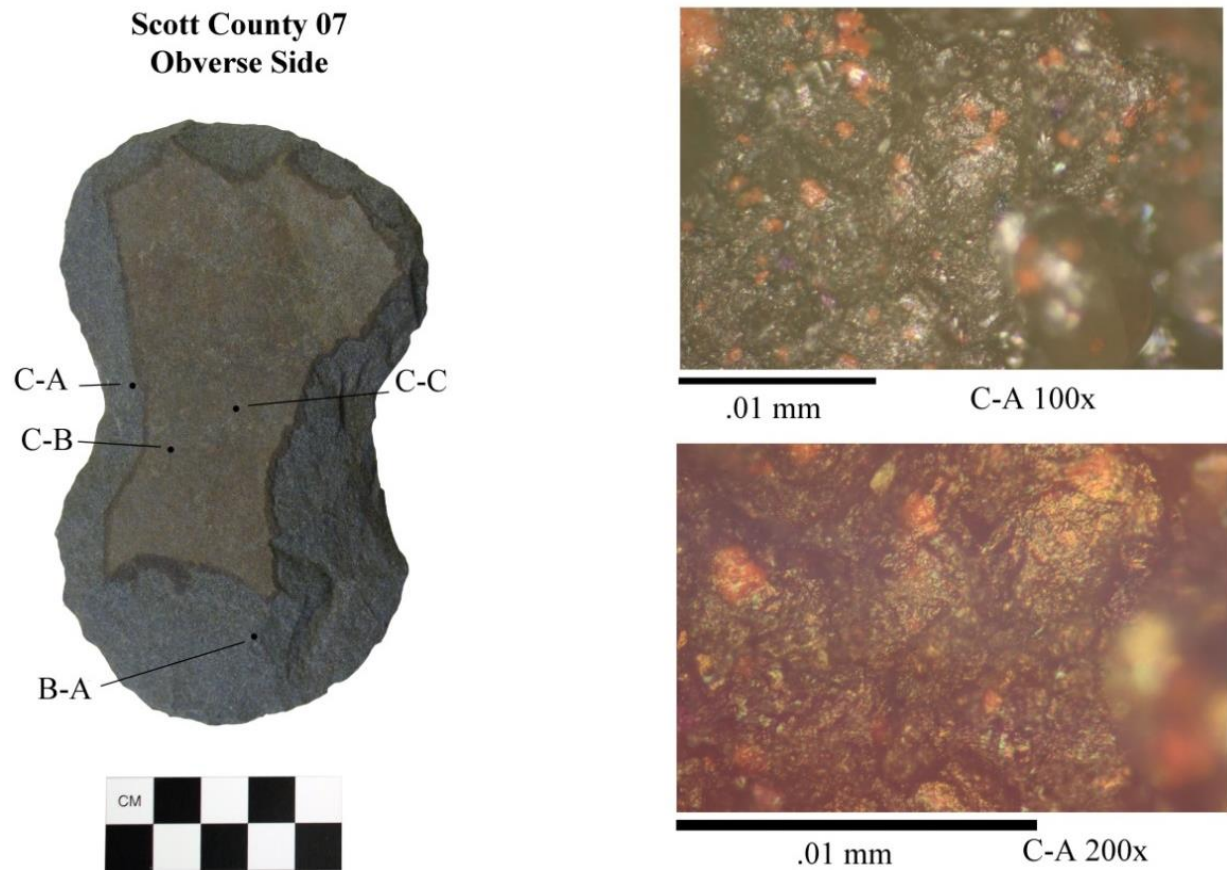
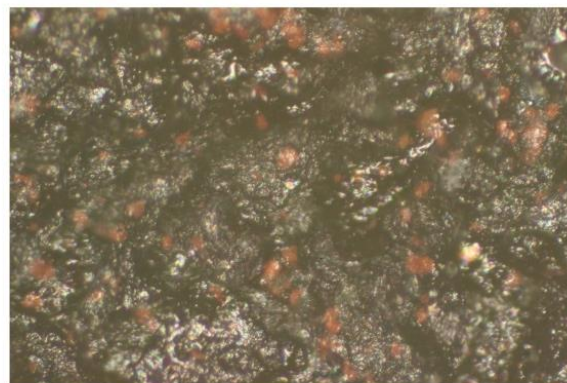
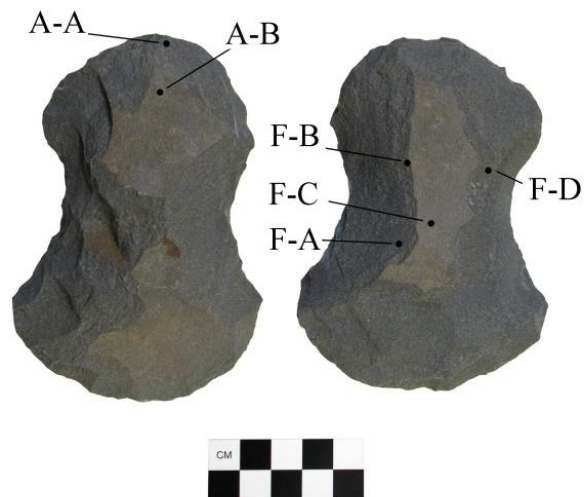


Figure 44. Experimental hafting wear on Scott County 07, Location C-A, showing generalized abrasive wear. Sinew was utilized as the hafting material.

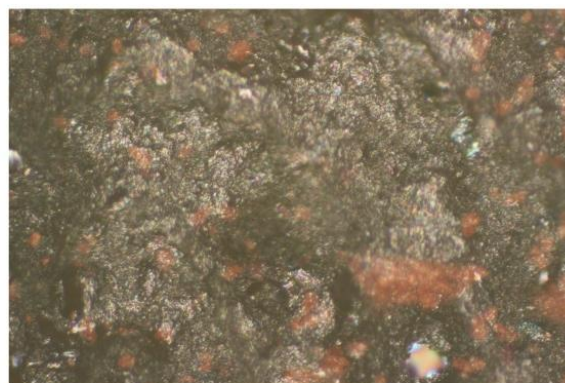
**Scott County 10
Obverse Side**

**Scott County 10
Reverse Side**



.01 mm

F-B 100x



.01 mm

F-C 100x

Figure 45. Experimental hafting wear on Scott County 10, Locations F-B and F-C, showing generalized abrasive wear. Sinew was utilized as the hafting material.

Experimental Replica Wear – General Conclusions

Woodworking Replica

In general, the single bitted tool worked better as woodworking axes, simply because they stayed in their handles for longer periods of time. Wear on the woodworking replicas consist of locations of generalized abrasion with few stand-alone locations of microplating additive wear. These portions of microplating tend to have small striations present.

Agricultural Replicas

These replicas worked wonderfully in the field with only one tool failure, which was due to a flaw in the wood in the handle. Use-wear consists of generalized abrasion covering large

portions of the tools. Wear is similar to what is seen on the woodworking replicas, but with the presence of large plane-like portions of microplating additive wear. Within these microplating areas, numerous overlapping multi-directional striations can be seen.

Animal Processing

This experimental type failed as a viable use for these tools. The replica was heavily damaged with use and the wear seen on this specimen is a different type than seen anywhere else in the study.

Experimental Hafting

The experimental hafting consisted of wear from multiple styles of hafting and varying types of material. The punch style hafting shows generalized abrasion caused by the movement of the tool or from the original placement. The central hafting for axes or hoes, shows large portions of light abrasive wear with the beginnings of microplating. Hafting material appears to have little effect on the wear produced.

Interpretation of Experimental Replicas

Minus some difficulties with certain tools, the Scott County experimental collection performed excellently in the field. Utilization as an agricultural tool was the most successful in both use and retention of the entire tool and handle. The agricultural implements tend to have more use-wear with greater definition and overlap, simply because these tools performed better in the field. During use, agricultural replicas stayed haft longer and produced more substantial wear. The replicas did function as axes, cutting down small trees and were quite adept at bark removal. The major issue with the experimental axes was finding a hafting form which maintained tool structure for long term use. The experimental woodworking axes also had

higher failure in the field causing these tools to generally have less wear than the agricultural tools (See Appendix 3 for all results).

With the exception of a few outliers, the experimental replicas reproduced both the abrasive and additive wear seen on the archaeological collection. The bit edge use-wear on the experimental replicas is fairly similar for both the agricultural and woodworking groups with wear consisting of additive in the form of microplating and abrasive in the form of generalized smoothing and striations. However, there are slight differences. The agricultural replicas have larger plane-like microplating wear with numerous multi-directional striations. The presence of wear on the agricultural tools is greater and covers more of the tool. The woodworking replicas tend to have larger areas of generalized abrasion with smaller individual locations of microplating which tend to be located closer to the bit edge. Striations on these locations are smaller in size and number.

The experimental collection was hafted in a variety of forms using numerous materials to attempt to recreate the wear seen on the archaeological collection. While certain tools and hafting forms produced more wear, the wear itself was similar no matter the tool style or hafting material used. The agricultural replicas produced hafting wear similar to what is seen on the archaeological collection, with large plane-like microplating with some replicas even recreating the directional striations. The hafting wear seen on the woodworking replicas is more abrasive without the large microplating seen on the other experimental tools. Wear on these replicas is also fewer in number and smaller in size.

The variation of binding materials (bark, sinew, cordage, raw hide) did not make any substantial difference on the use-wear of the tool. Certain materials were better at adhering the

tool to the handle, creating longer experimental use time. The animal by-products, sinew, raw hide and leather were the most effective materials used.

The experimental collection does lack obvious variation of use-wear especially when compared to the numerous differences in use, form, hafting, handles, and volunteers used in this study. The differences tend to be more subtle, which is similar to the little variation seen on the archaeological collection.

This lack of variation in the experimental wear could be attributed to a couple of factors. First, the experimental tools were simply not used long enough. The amount of time in the field potentially did not allow for the variation of wear from differing contact materials or haft bindings to be created on the tools. The length of time the experimental replicas were used definitely had an impact on the wear. Use-wear on the experimental replicas was lighter and of lower quality and quantity compared to the archaeological collection. However, the wear on the experimental tools still replicates that of the archaeological collection, suggesting that extended experimental use would only recreate more of the same wear with the continued lack of obvious variation. The second potential reason for the lack of variation on wear is that the experimental collection was not utilized or hafted in the same way as the original archaeological tools. While this is a possible explanation, again the experimental replicas recreated the wear seen on the archaeological collection; therefore how the experimental tools were utilized at minimum reflects parts of the original usage. The third explanation is the material from which these tools are made is not affected by such differences on a microscopic level. The density of the silicified sandstone or the composition of the material itself may not be conducive for such minute differences in contact material, hafting and this wear is simply not visibly present. The fourth potential reason is that the archaeological collection actually has a continuum of wear and the

experimental replicas reflect that continuum. This hypothesis will be examined in greater detail further in this chapter.

While the use-wear on the experimental tools is not as substantial or numerous as the wear seen on the archaeological collection, it is still representative and gives an indication as to how microscopic use-wear is produced on silicified sandstone tools. Additive wear is seen on many of the experimental replicas, revealing that microplating wear occurs rather quickly on these tools.

Woodworking tool wear tends to consist of generalized abrasion with stand-alone locations of microplating. If microplating does exist, there is commonly the presence of directional striations (Figures 32 and 46).

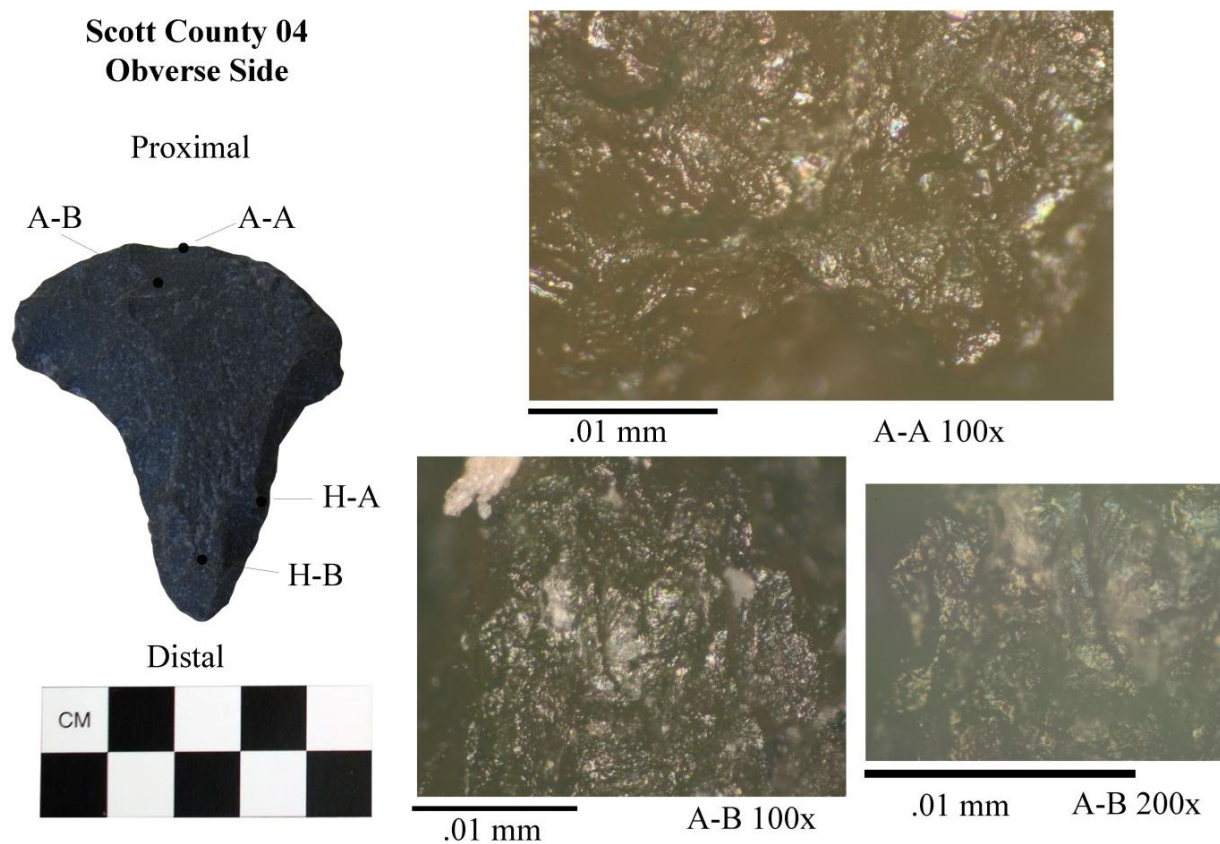


Figure 46. Generalized woodworking experimental wear pattern seen on the bit edge of Scott County 04, showing generalized abrasion.

Experimental agricultural tool wear is similar to the woodworking tools, but with the addition of larger plane-like areas of microplating (Figures 34 and 36). The agricultural experimental tools also have the generalized abrasion seen on the woodworking tools but it is not as common.

Archaeological Collection Results

The use-wear analysis of the archaeological collection is described by the categories listed in Chapter 2 for ease of description and to highlight patterns of wear throughout the groups. Just like the experimental collection, the hafting wear is discussed separately from the bit wear. This section describes the overall characteristics of each category as well as any outlying or significant difference among the tools. For the complete use-wear images and detailed description for each artifact see Appendix 2.

Practice Piece/Toys Tools

Based on tool form and primary observations prior to microscopic work, tools in this group were originally hypothesized to have little use-wear. If wear was present, it would be attributed to the production of the piece than actual use. This theory was based on the rough, chunky forms and minimal appearance of well-defined knapping. However, when the casts were analyzed, the original hypothesis of wear was proven incorrect. The tools in the practice pieces/toy category contain a significant amount of use-wear on both the bit edges and central hafting portions. Tools wear consists of both abrasive and additive wear. One major concern with this category is many of the artifacts have plow scars or damage which occurred after initial abandonment (see Artifacts 013, 017, 018, 055, 062, and 065). This damage could easily disturb

the wear which is seen and potentially create wear from the tools' movement through the soil. The analysis of these tools still occurred, but the potential error needs to be taken into account.

Bit wear on Practice Pieces/Toys

The bit wear on these tools consists of heavy abrasion located near the edges, which reduces in quantity as the examination moves closer to the central portion of the tool. Additive microplating wear creates large flat planes where striations can sometimes be seen. Additional abrasive wear can be seen on top of the microplating. Striations tend to run perpendicular to the bit edge, however, can be slightly at an oblique angle off of true 90 degrees (Figures 47-49).

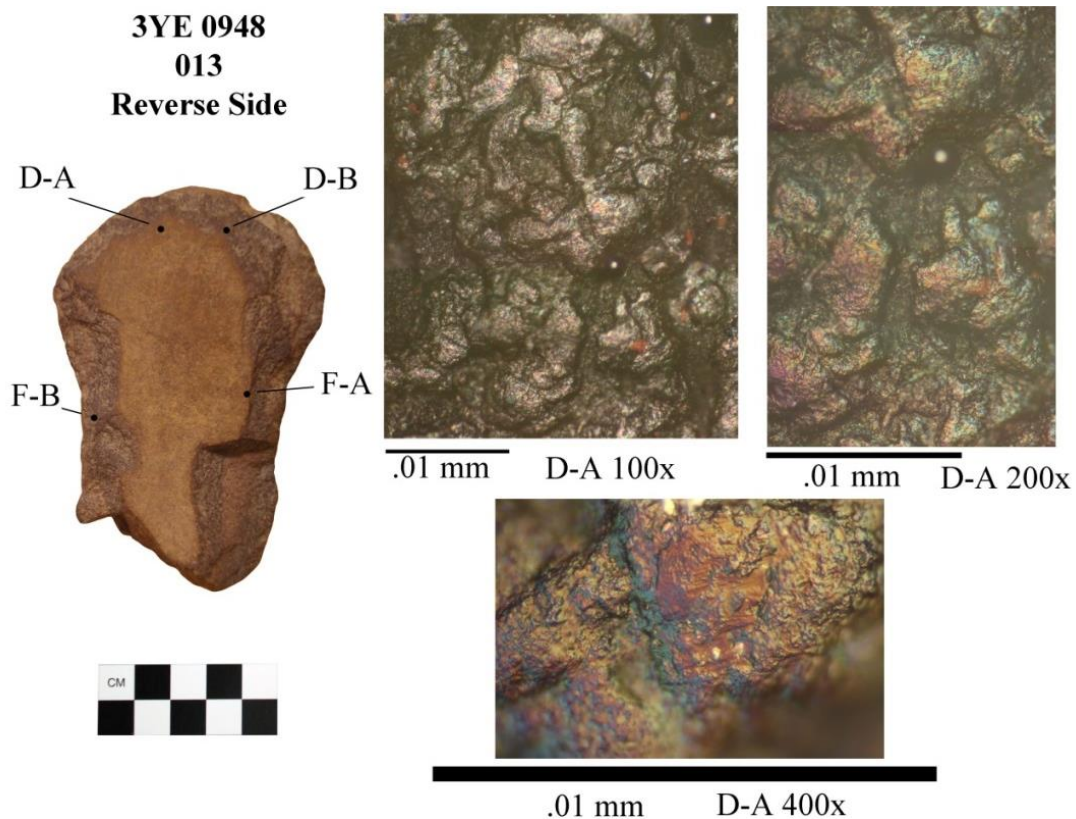


Figure 47. Additive bit edge wear on Artifact 013, Location D-A, showing filled in striations and later abrasive wear. This wear is seen near the edges of all of the tools within the practice piece/toy category in the archaeological collection.

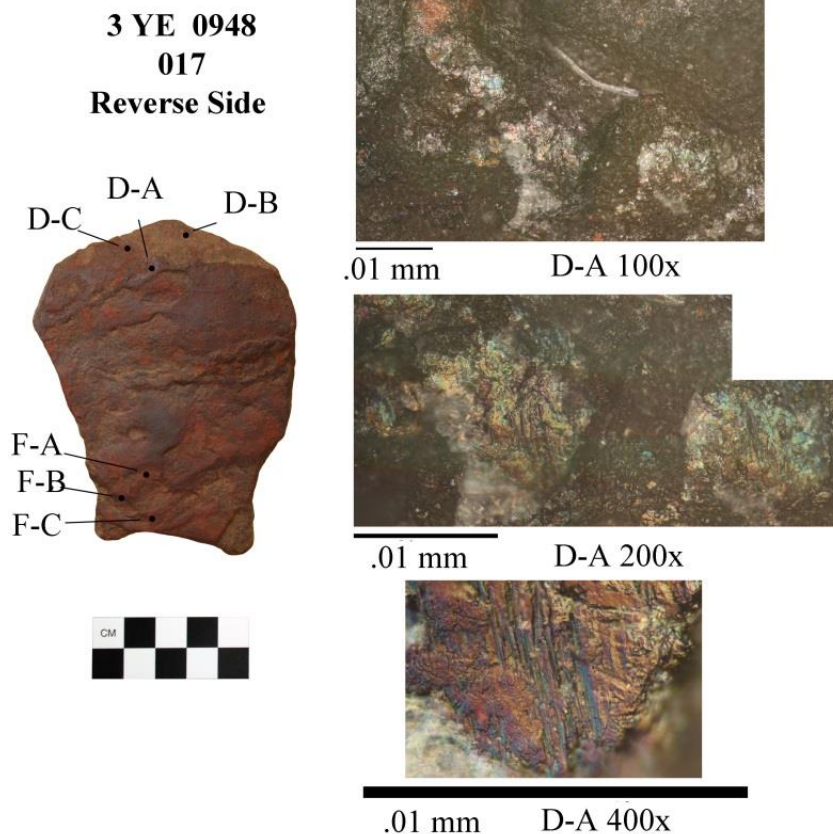


Figure 48. Striation wear on Artifact 017, Location D-A. Wear is perpendicular to the bit edge and has evidence of microplating, with filled in striations, crystalized filaments and abrasive wear on the silica gel.

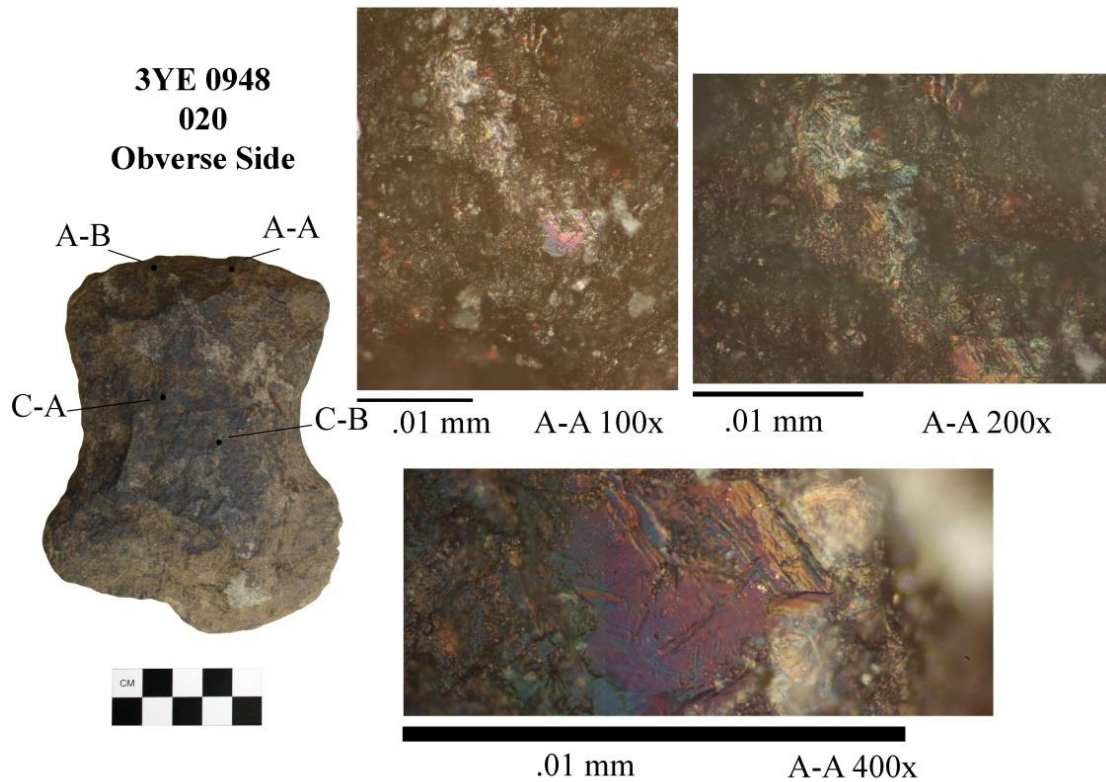


Figure 49. Striation wear on Artifact 020, Location A-A, showing both additive and abrasive wear. Microplating is present with addition of silica gel, filled in striations, crystalized filaments and later abrasive wear on top of the additive. The majority of the wear is slightly oblique to bit edge, but some striations are multidirectional.

Hafting wear on Practice Pieces/Toys

Hafting wear consists of large portions of abrasion found throughout the central portion of the tools (Figures 50 and 51). Select tools have dense striations within these abrasion sections, suggesting the presence of particles trapped within the hafting (Figure 52). Portions of these tools show the beginnings of microplating wear.

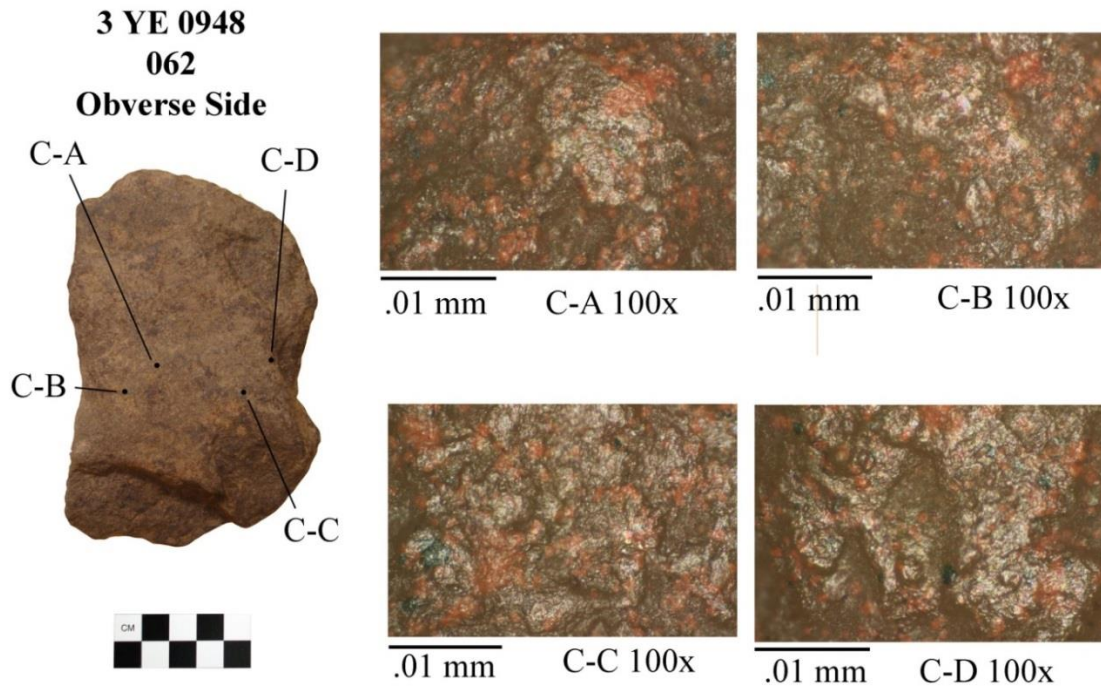


Figure 50. Generalized abrasion wear on hafting portion of Artifact 062, Locations, C-A, C-B, C-C and C-D.

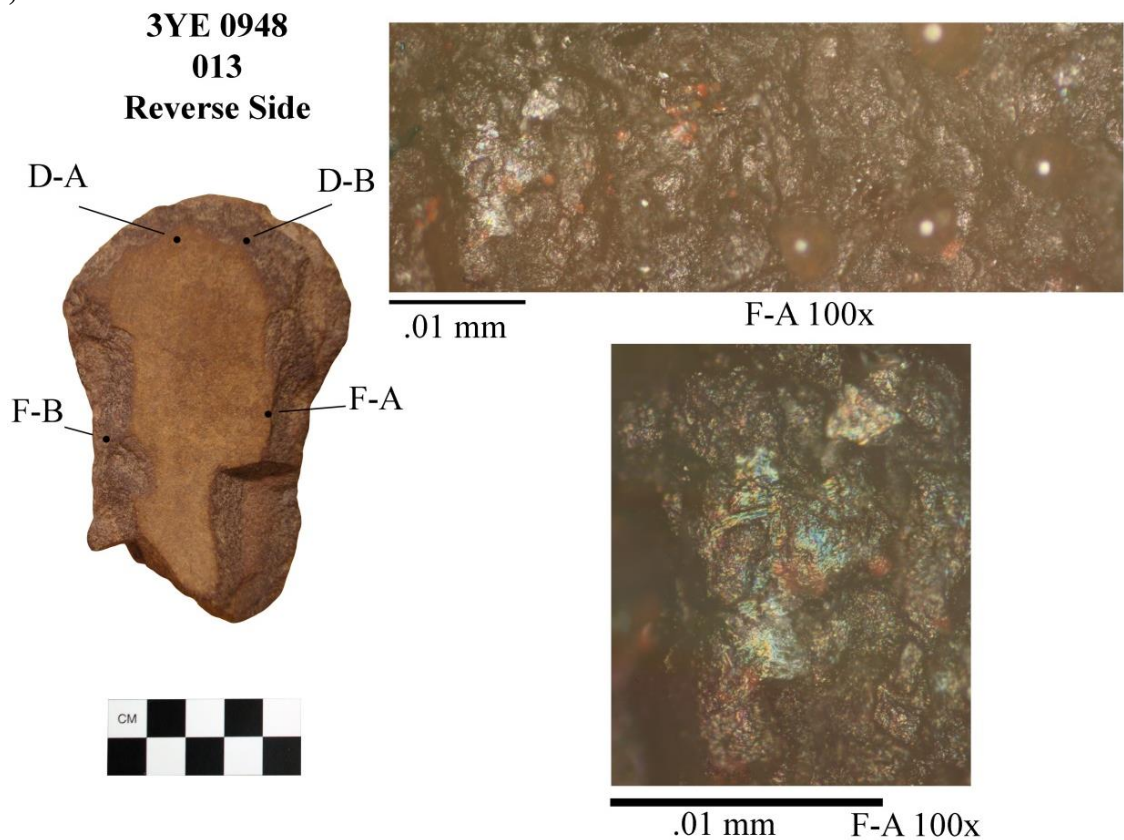


Figure 51. Generalized abrasion wear on hafting portion of Artifact 013, Location F-A. This location also has additive wear and slight microplating.

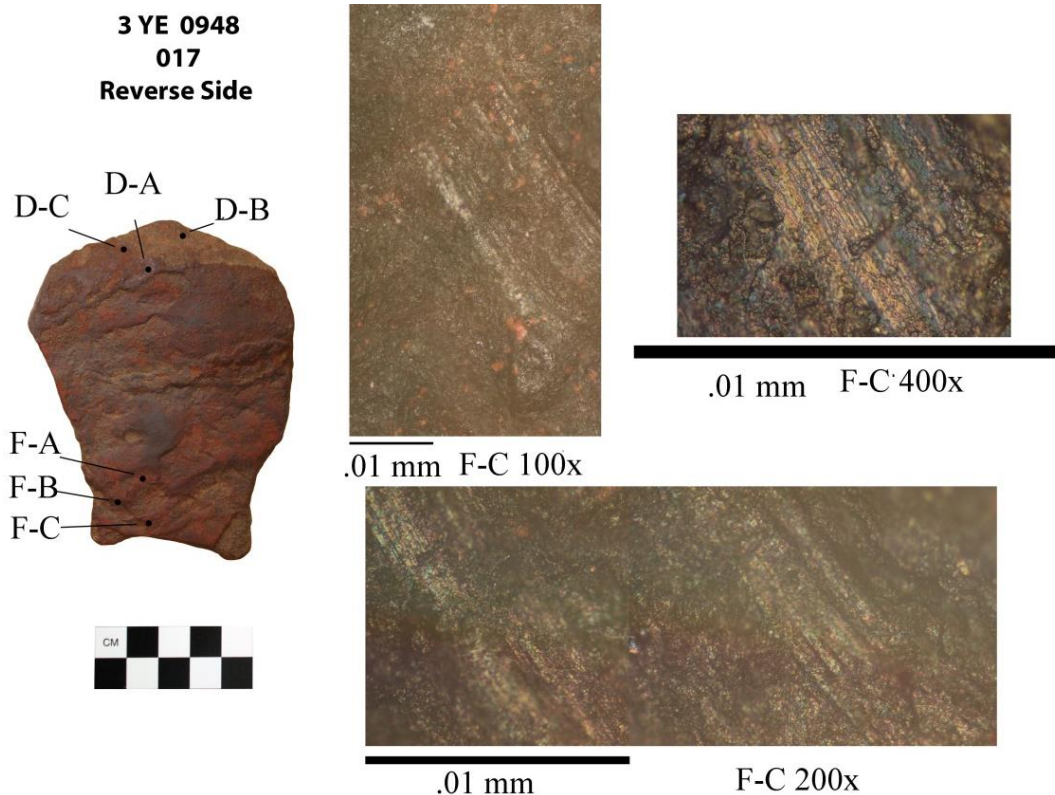


Figure 52. Abrasion wear plus striation wear on the hafting portion of Artifact 017, Location F-C, showing oblique striations which are slightly filled in from microplating.

Double Bitted Tools with Triangular Edges

The triangular edged tools were original hypothesized to be in the early stages of the tool life cycle. Having little macro-wear, they were thought to have been abandoned prior to heavy use. However, these tools do have significant abrasive and additive wear, but less than what is seen on the rest of the collection.

Bit Edge Wear on the Double Bitted Triangular Edged Tools

Wear on the triangular edged tools is consistent among all five in this category. Wear consists of smaller portions of heavy abrasion with locations of significant striations (Figures 53-55). Wear is consistent on both bit edges of the tool. Striations tend to be obliquely perpendicular to the bit edge.

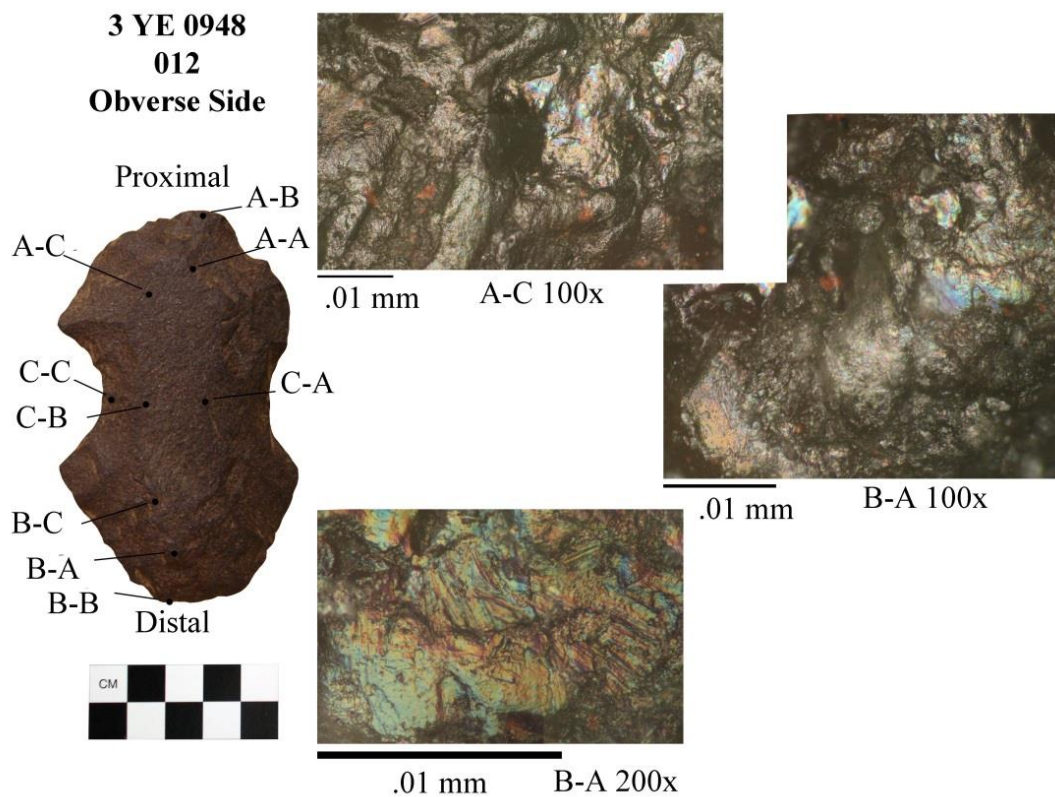


Figure 53. Bit edge wear on Artifact 012. Abrasive wear can be seen in Locations A-C and B-A. Location B-A also shows overlapping striations obliquely perpendicular to bit edge.

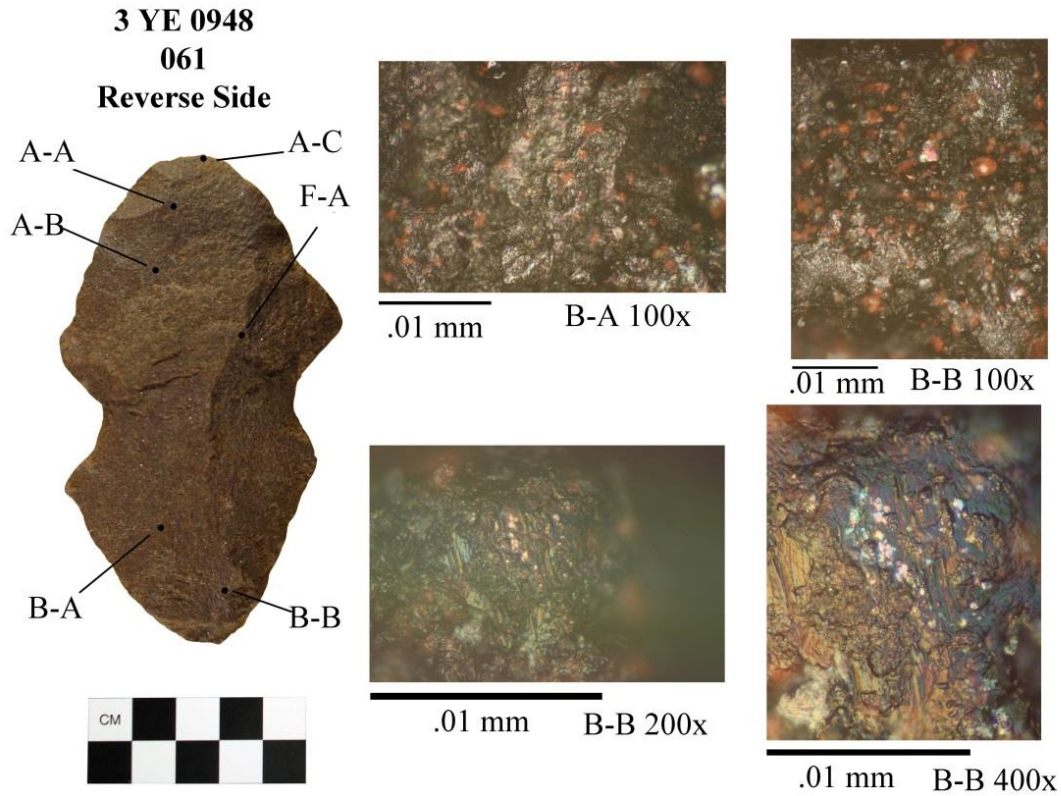


Figure 54. Bit edge use-wear on Artifact 061, showing abrasion wear in Location B-A and B-B and striation wear perpendicular to the bit edge in Location B-B.

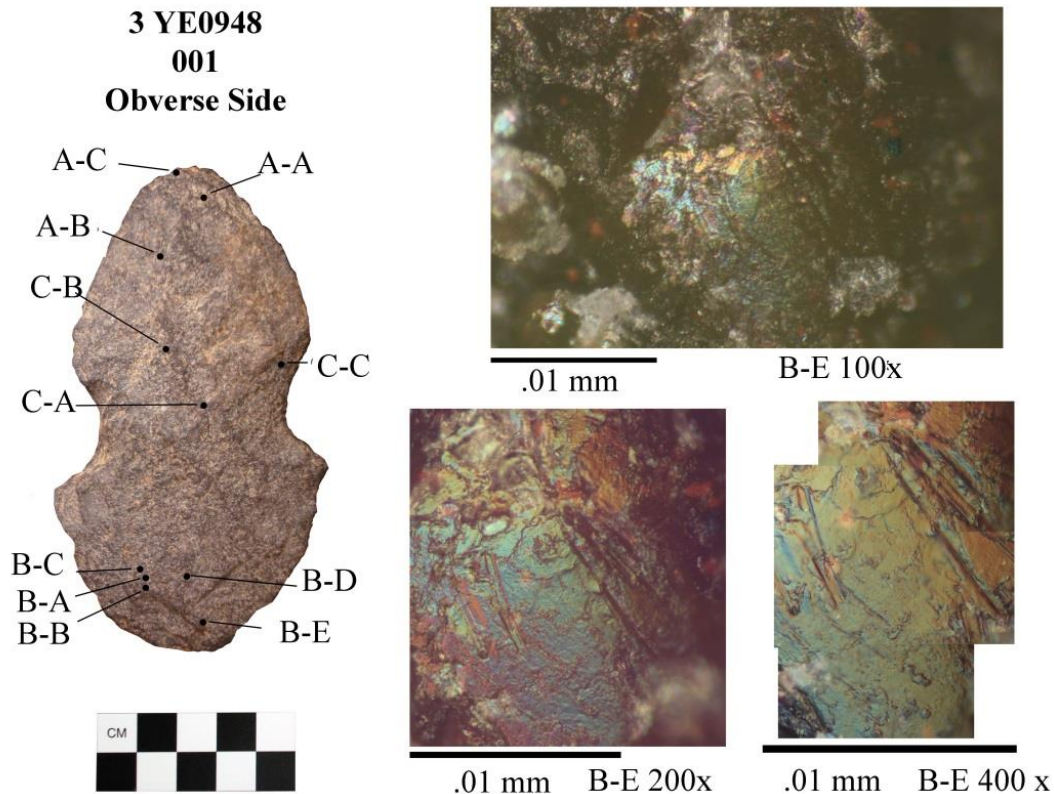
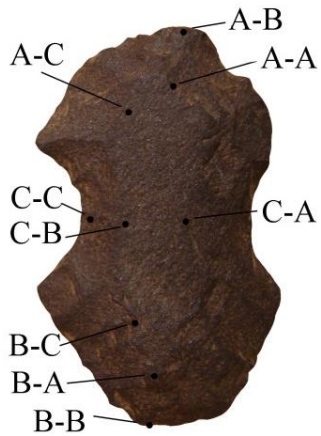


Figure 55. Bit edge use-wear on Artifact 001, Location B-E, showing abrasion and striations obliquely perpendicular to bit edge with minimal overlapping of older striations.

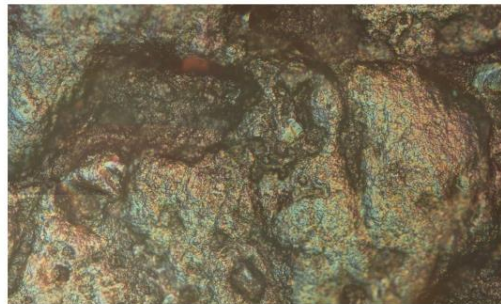
Hafting Wear on the Double Bitted Triangular Edged Tools

Hafting wear on the triangular edge double bitted tools with is consistent throughout the category with heavy, large portions of additive and abrasive wear present (Figures 56 and 57). Additive wear consists of large planes of microplating which has heavy abrasion from smoothing and striations. Striation wear is not common throughout, and is caused by small particles trapped in the hafting. If striations are present, they are usually heavy and numerous with lots of overlap and tend to run parallel to the bit edge. The hafting wear in this category is consistent with hafting wear throughout the archaeological collection.

3 YE 0948
012
Obverse Side



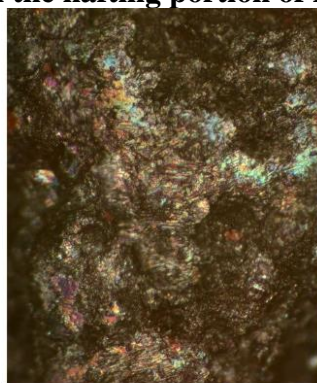
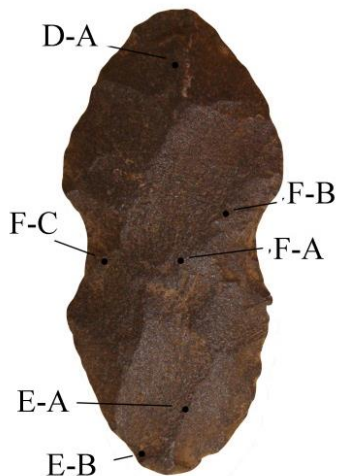
.01 mm C-A 100x



.01 mm C-A 200x

Figure 56. Abrasion use-wear on the hafting portion of Artifact 012, Location C-A.

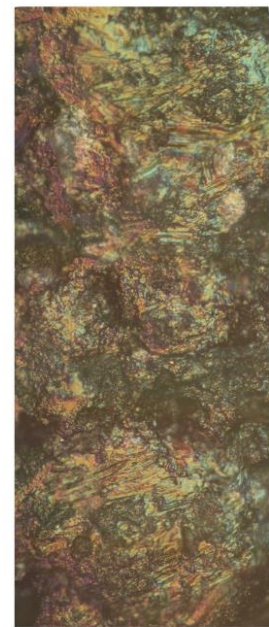
3 YE 0948
009
Reverse Side



.01 mm F-B 100x



.01 mm F-B 400x



.01 mm F-B 200x

Figure 57. Abrasion and striation use-wear on the hafting portion of Artifact 009, Location F-B, showing microplating and striations.

Double Bitted Tools with Rounded Edges

Rounded edge double bitted tools have considerable wear on both bits and heavy polishes in the hafting region. The rounded edges are thought to be visual representations of longer use of the tools, due to reduction of the edge from use and re-sharpening events.

Bit Edge Wear on the Rounded Edged Double Bitted Tools

Wear consist of large planes of microplating additive wear which has been highly abraded down to a smooth surface (Figures 58-60). This wear covers sizeable portions of the tool surface and contains striations which run mostly perpendicular to the bit edge. The striations show evidence of multiple periods of use, with overlapping occurring in multiple directions and multiple locations of partially filled in wear. Use-wear is similar on both bit edges of the tools, suggesting related consistent use of both ends.

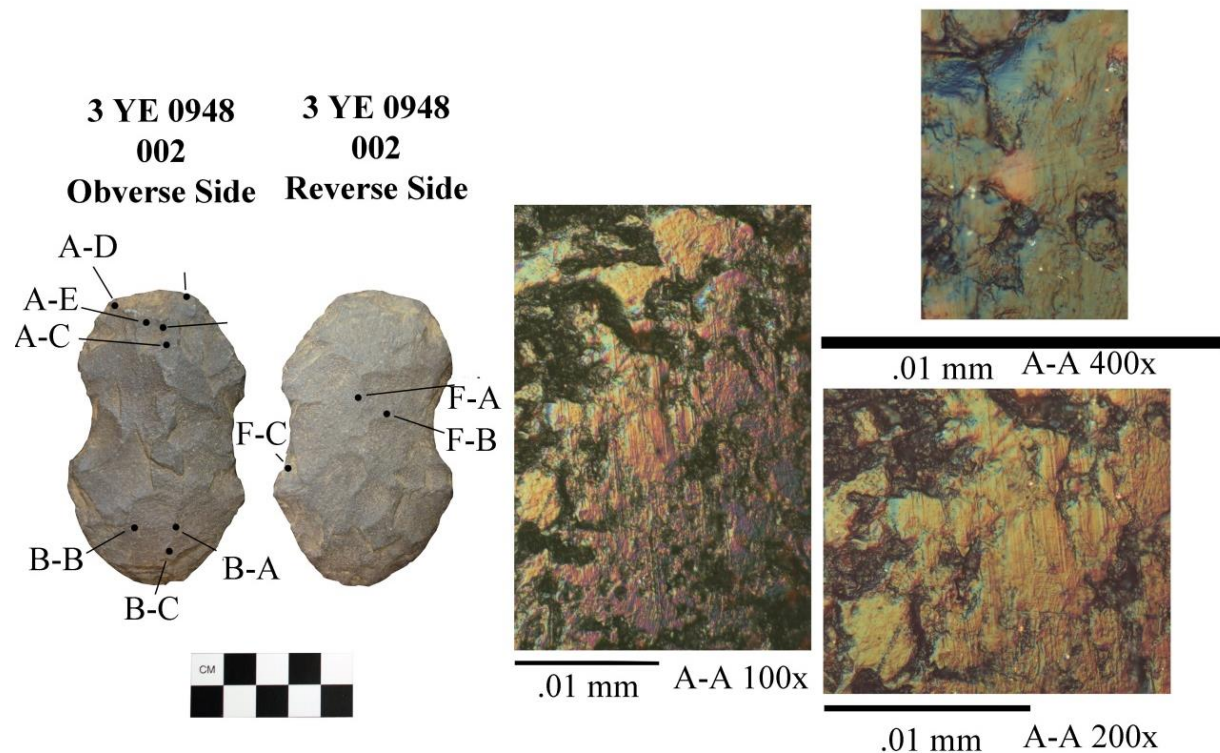


Figure 58. Bit edge wear on Artifact 002, Location A-A, showing additive wear with heavy abrasive and striation wear running perpendicular to bit edge.

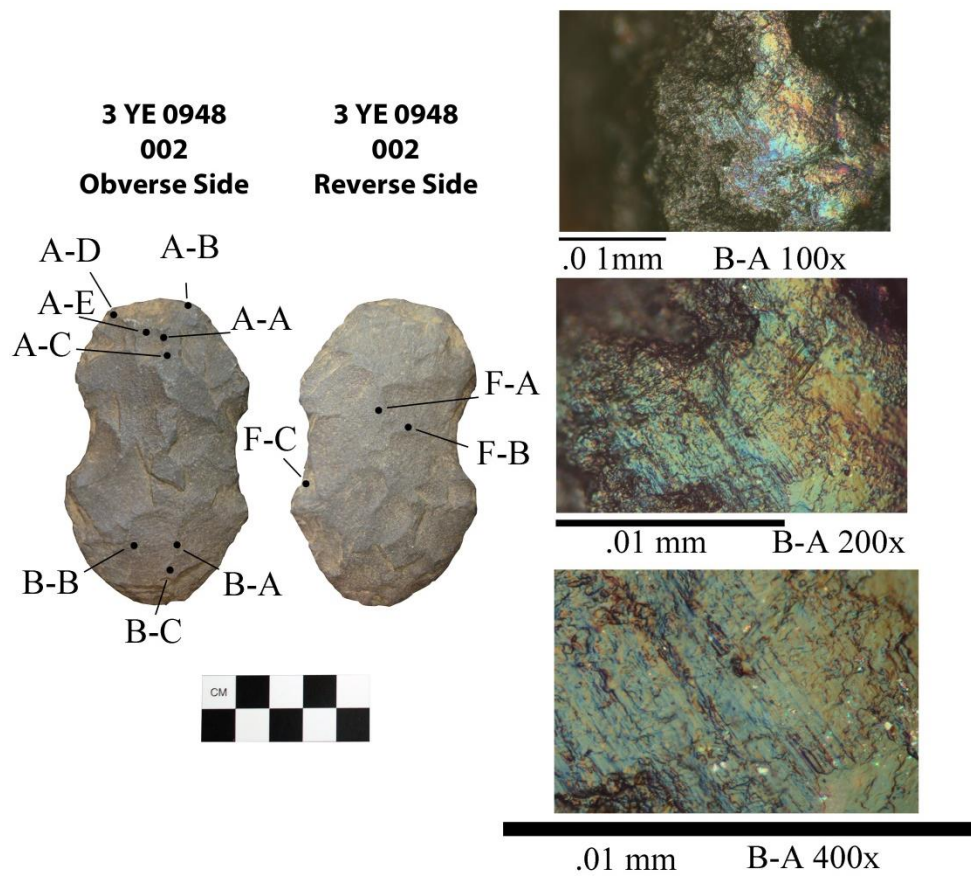


Figure 59. Bit edge use-wear on Artifact 002, Location B-A, showing obliquely perpendicular striations on top of profoundly smoothed microplating wear.

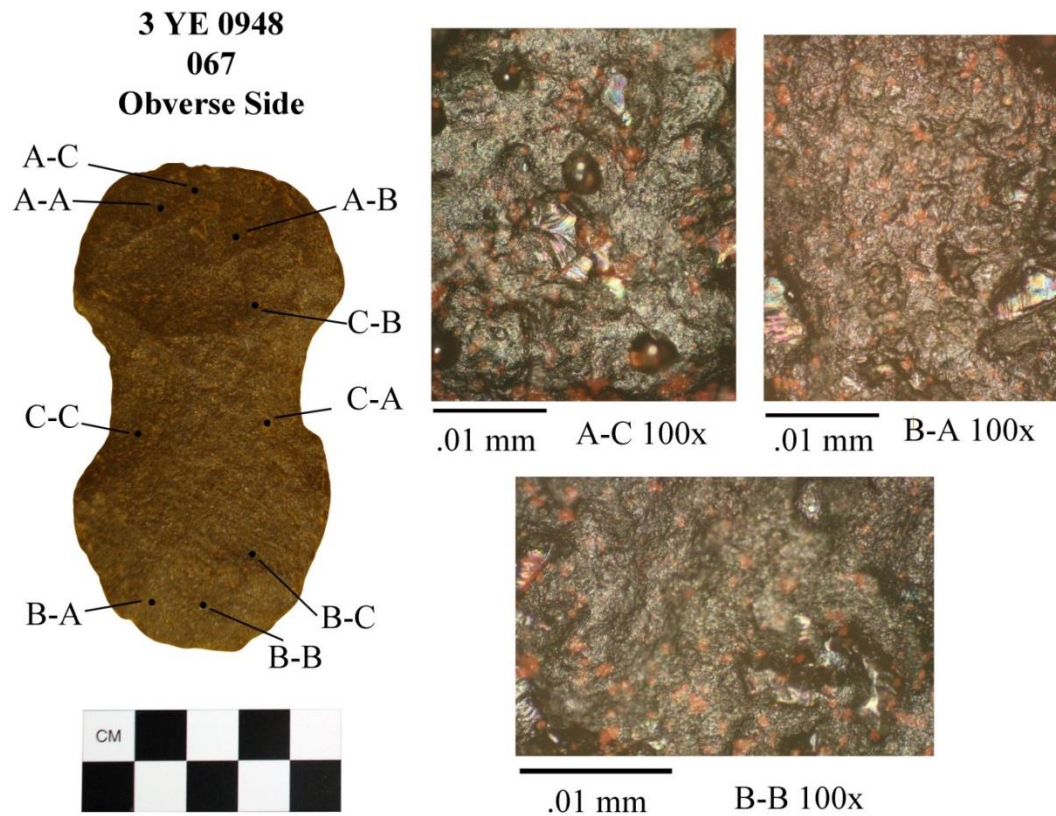


Figure 60. Use-wear on the bit edge of Artifact 067, Locations A-C, B-A, and B-B, showing large planes of abrasive wear with the beginnings of additive wear.

Hafting Wear on the Double Bitted Tools with Rounded Edges

Hafting wear for this category is consistent with other wear throughout the collection and consists of abrasive and microplating additive wear which has been heavily abraded with few striations (Figures 61 and 62). Hafting areas on the tools show significant macro-wear with smoothing and polish present. Microscopically the tools have significant wear, with the majority of hafting region having substantial abrasion.

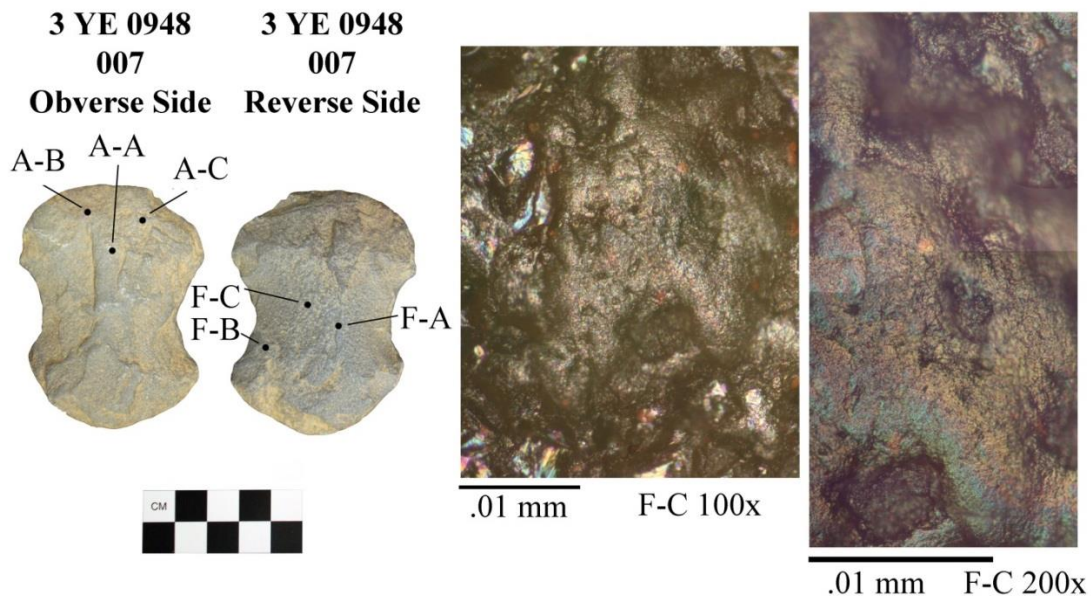


Figure 61. Hafting wear on Artifact 007, Location F-C, showing abrasion of previous microplating wear.

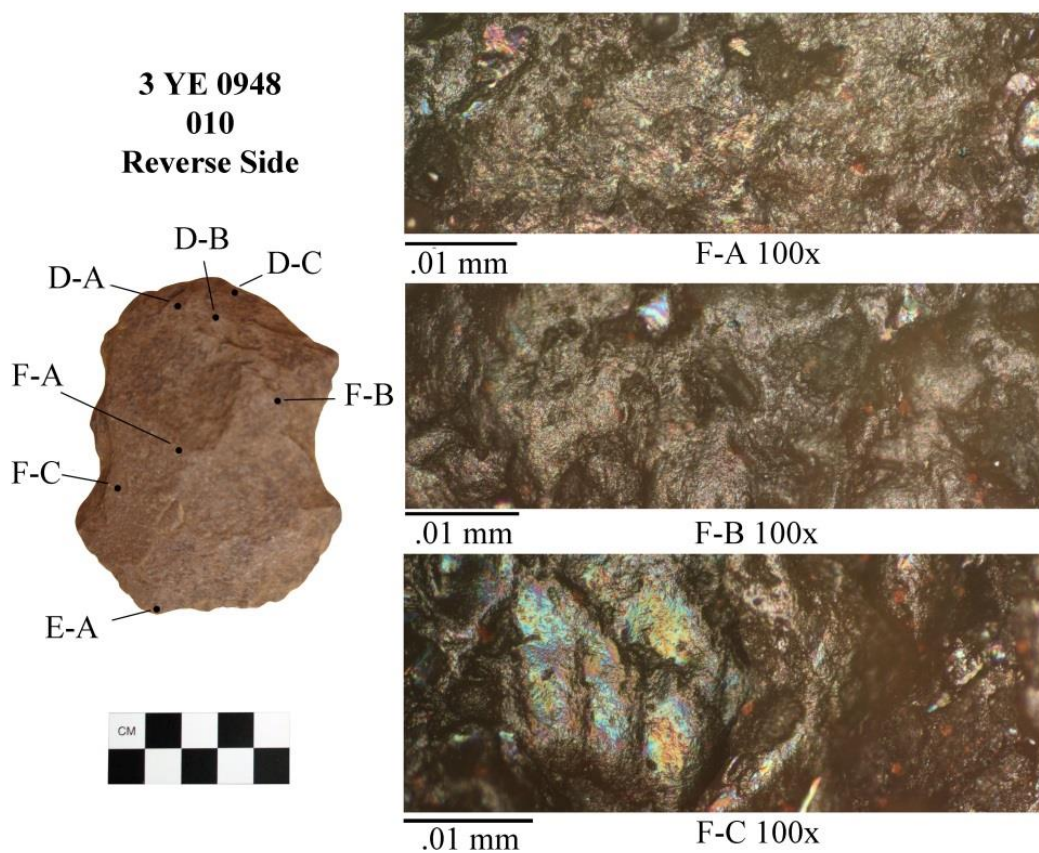


Figure 62. Hafting wear on Artifact 010, Locations F-A, F-B and F-C, showing abrasion of previous microplating wear.

Damaged Double Bitted Tools

This category has the largest number of artifacts from the archaeological collection and contains tools which retain one bit edge and a portion of the hafting or tools which have only haft areas intact. Since these are damaged double bitted forms, the wear should be similar to the double bitted category, unless they were utilized for additional purposes after damage occurred. After microscopic analysis, this original hypothesis was proven correct.

Bit Wear on Damaged Double Bitted Tools

Wear on the damaged double bitted tools consist of large portions of abraded microplating wear with areas of heavy striations obliquely perpendicular to the bit edge (Figures 63-65). Wear on these tools is heavy and covers large portions of the tools. The use-wear does not show overwhelming evidence of a difference between the damaged double bitted and the complete double bitted, suggesting these damaged tools were not usually modified after the damage occurred.

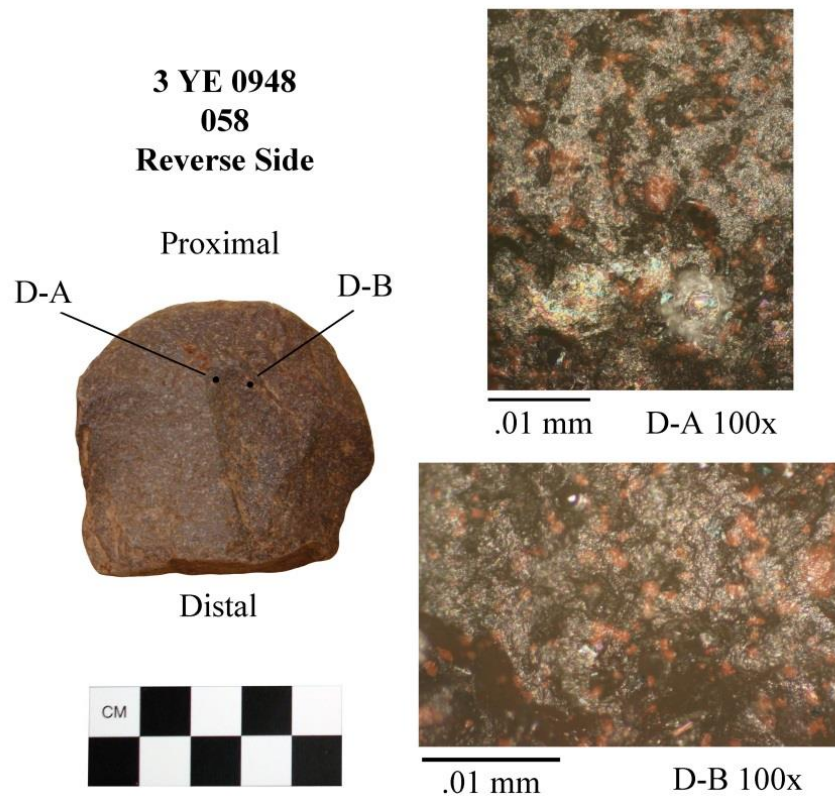


Figure 63. Bit edge use-wear on Artifact 058, Locations D-A and D-B, showing heavy abrasion with the beginnings of microplating.

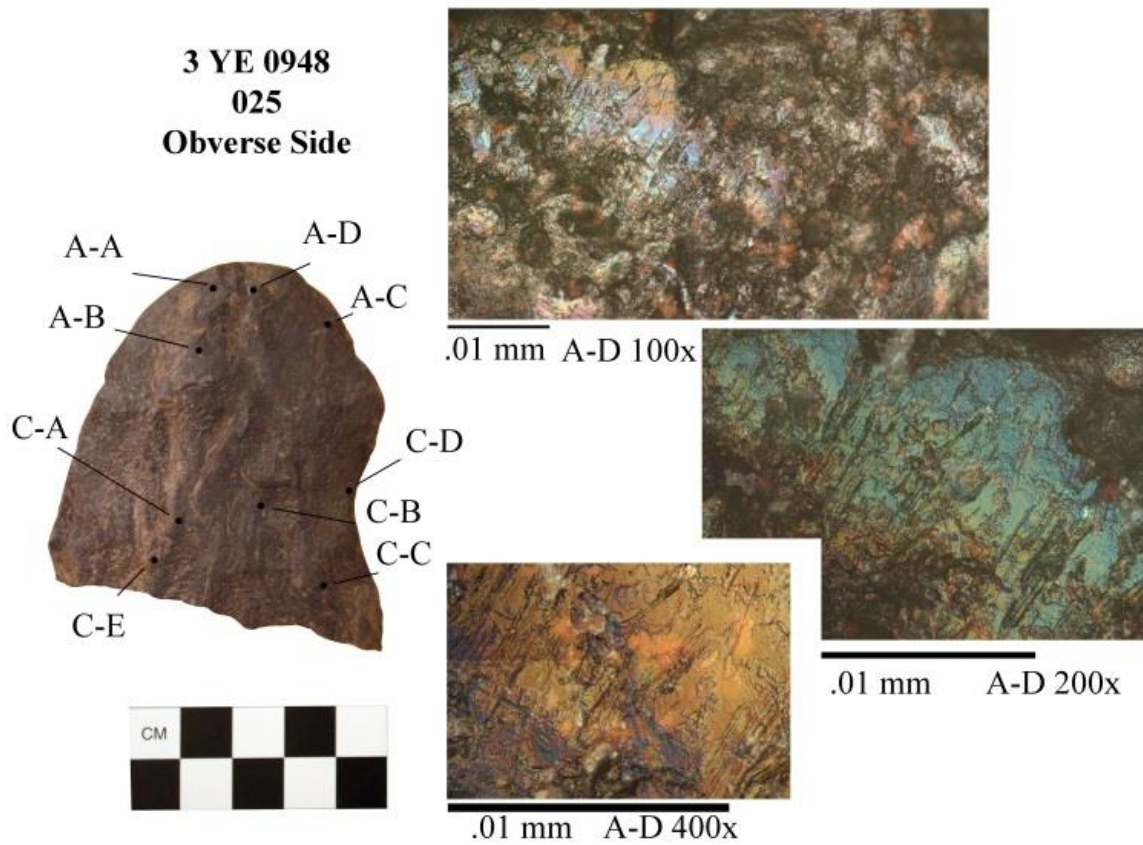


Figure 64. Bit edge use-wear on Artifact 025, Location A-D, showing heavy abrasion of the previously microplating wear and obliquely angled striations.

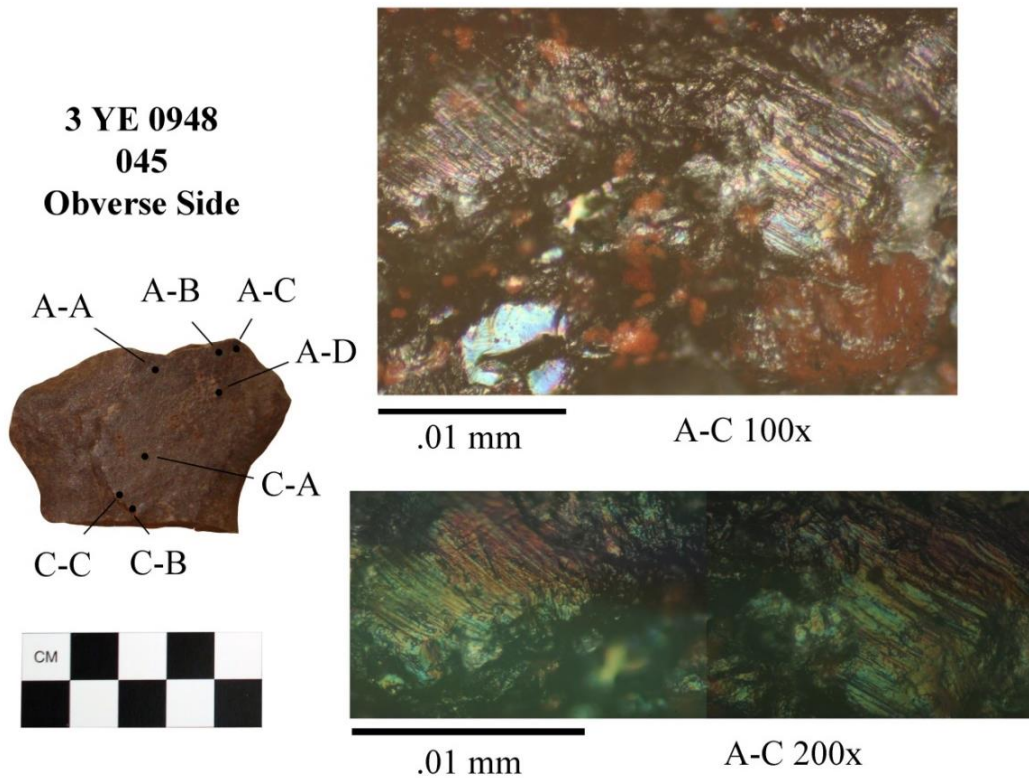


Figure 65. Bit edge wear on Artifact 045, Location A-C showing heavy microplating wear with numerous obliquely angled striations.

Hafting Wear on the Damaged Double Bitted Tools

The hafting wear for this category is also the same as the wear seen on the complete double bitted tools. The wear on the tools in this category consists of large portions of additive and abrasive wear with some large groupings of striations (Figure 66-68). Abraded areas of microplating and filled in striations can be seen. The wear on the hafts is highly directional, running perpendicular to the tool's longitudinal axis.

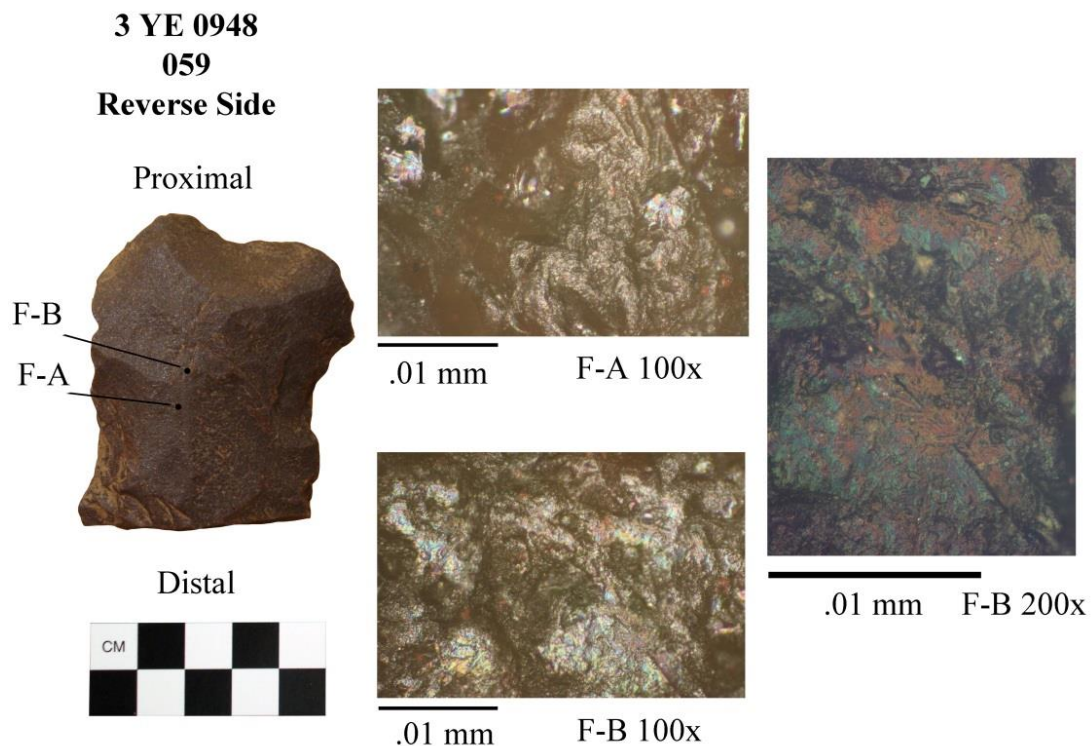


Figure 66. Hafting wear on Artifact 059, Locations F-A and F-B, showing abrasion and striations.

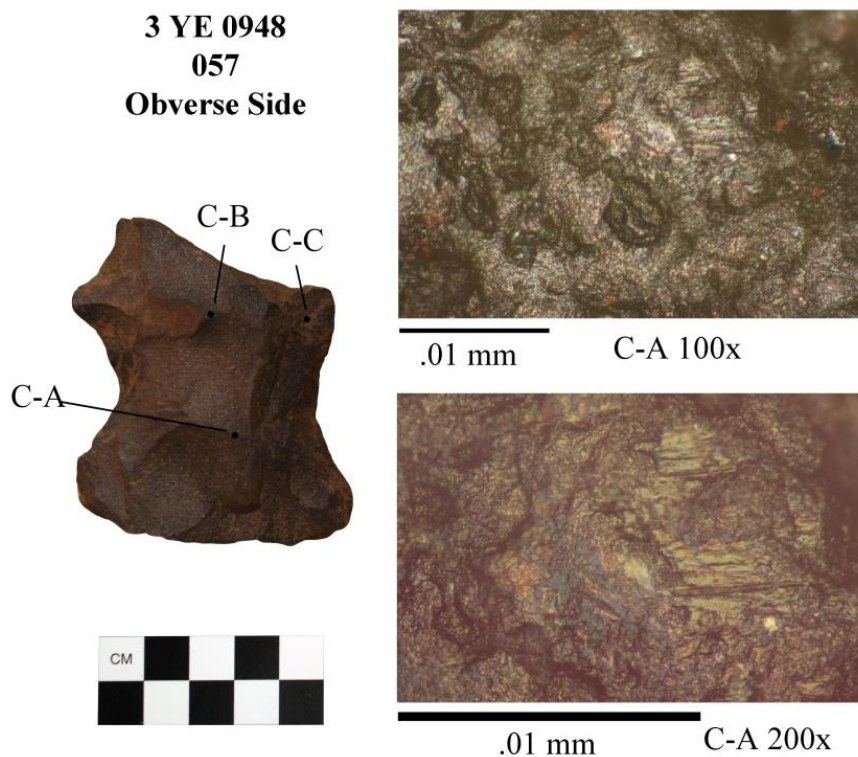


Figure 67. Hafting wear on Artifact 057, Location C-A, showing heavy directional abrasion and striations.

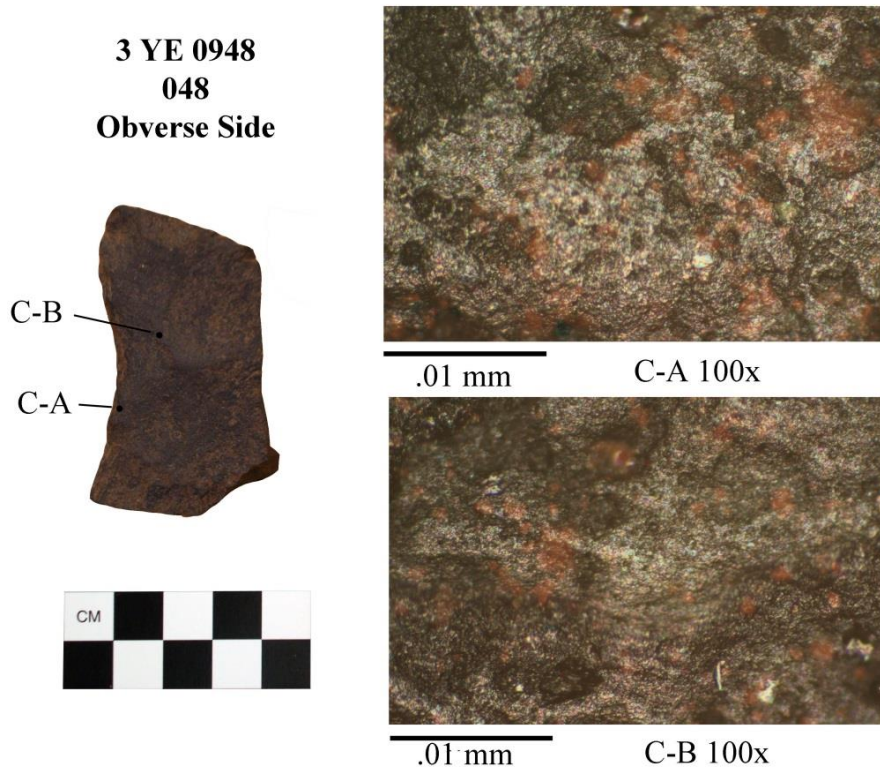


Figure 68. Hafting use-wear on Artifact 048, Locations C-A and C-B, showing heavy directional abrasive wear.

Single Bitted Tools

The single bitted tool form was originally thought to be a modification of the double bitted form after massive tool failure. The original hypothesis was that wear would be similar to that of the double bitted, unless after the modification the function of these tools changed. There are six tools from the archaeological collection in this grouping and all of the tools have significant rounding of the bit edge.

Artifact 040 is a unique tool in this category (Figure 69). It is one of only two tools in the entire collection made of slate and appears to have been ground as opposed to knapped. This tool is likely a distal end of the grooved axe, than the chipped stone tools which make up the

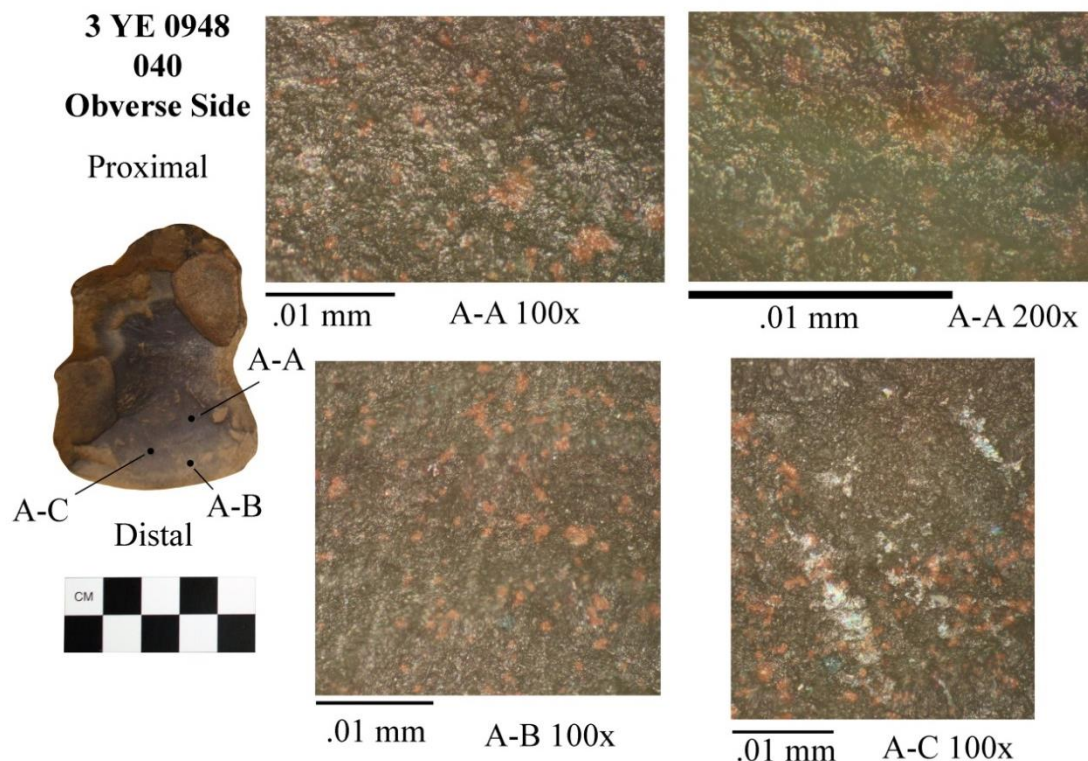


Figure 69. Use-wear on Artifact 040, Locations A-A, A-B and A-C, showing light abrasion throughout. This tool is most likely a distal end of a grooved axe, as opposed to the chipped stone silicified sandstone tools which make up the rest of the archaeological collection.

remainder of the archaeological collection. The wear seen on Artifact 040 is more consistent with hafting; light, continuous, generalized abrasion.

Bit Wear on the Single Bitted Tools

Bit wear on the tools in this category is similar to wear seen on the rest of the archaeological collection. The wear appears plane-like and is the results of heavy smoothing on a microplating wear. The abrasion present is substantial and covers large portions of the tool edges. Striations on the tools' edges are multi-directional and continuously overlapping (Figures 70-71).

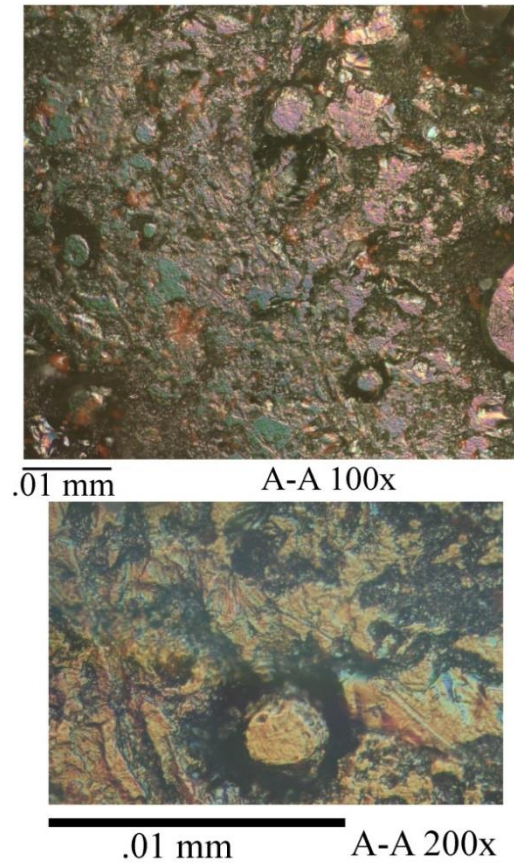
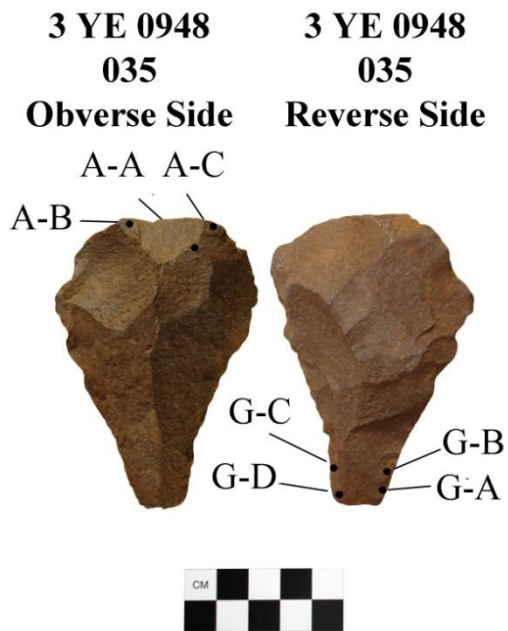


Figure 70. Bit use-wear on Artifact 035, Location A-A, showing abrasive wear on top of microplating with obliquely angled striations.

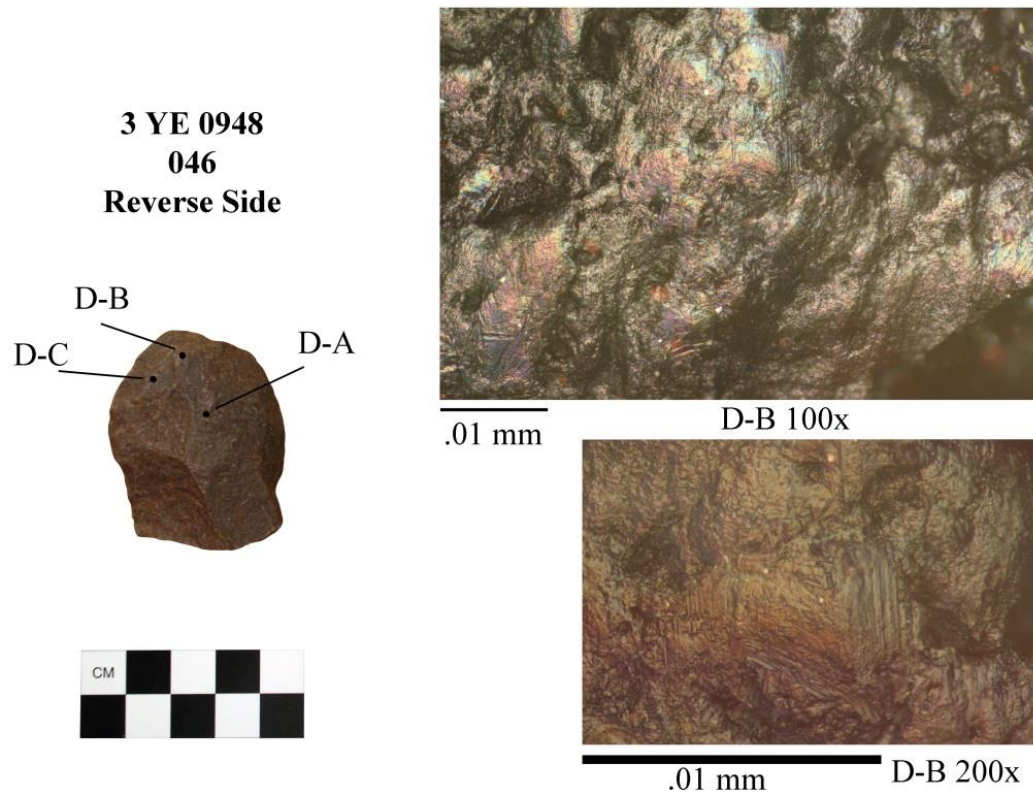


Figure 71. Bit edge use-wear on Artifact 046, Location D-B, showing abrasion on top of microplating with obliquely angled, overlapping striations.

Hafting Wear on the Single Bitted Tools

Hafting for the tools consists of light abrasive wear with few striations (Figures 72 and 73). Wear was lacking on these tools and difficult to find and tended to be located at the edge of the tool, with little smoothing present in the central areas.

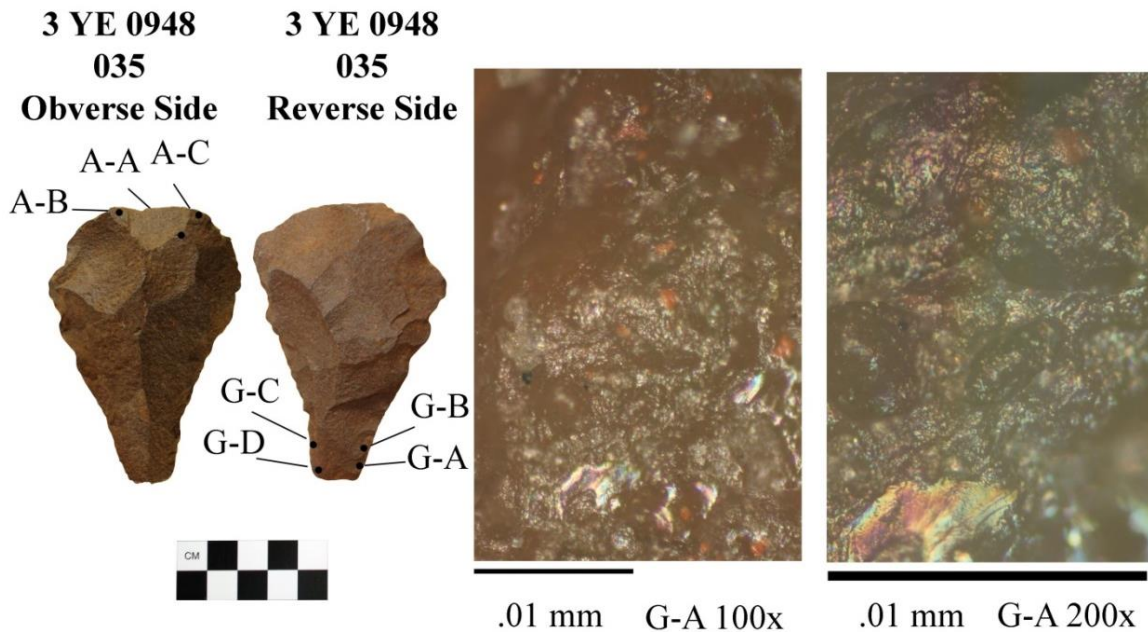


Figure 72. Hafting use-wear on Artifact 035, Location G-A, showing light abrasion wear, , with none of the heavy microplating seen on the other categories of tools.

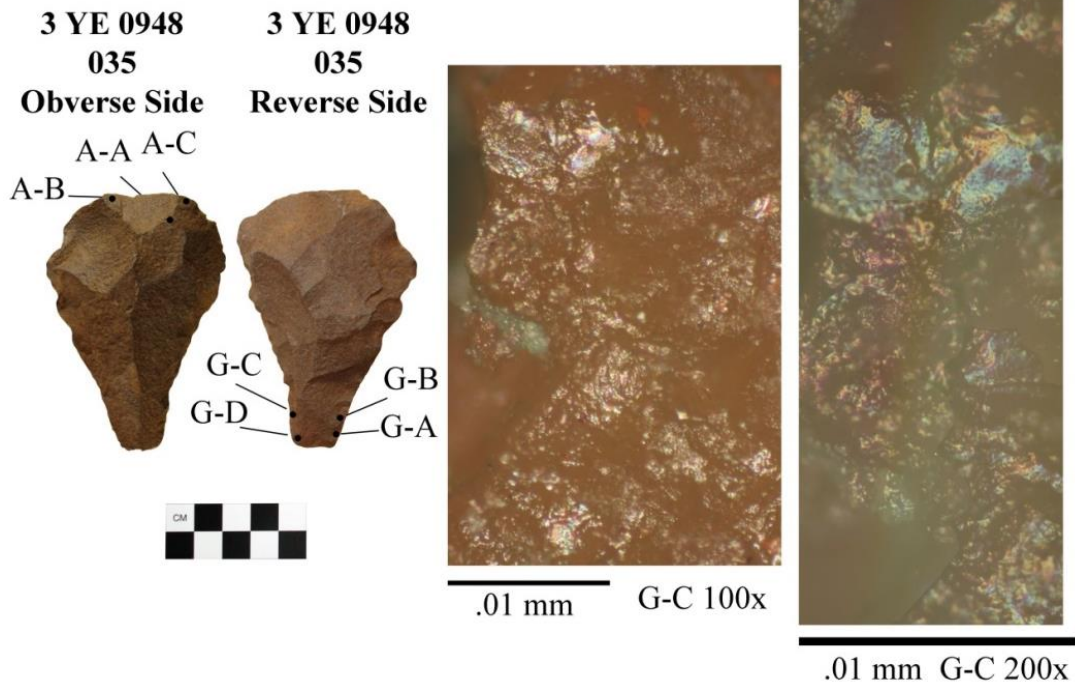


Figure 73. Hafting use-wear on Artifact 035, Location G-C, showing light abrasive wear and fracture quartz grains.

Elongated Tools with Triangular Edges

This category is the smallest of the collection, with only two tools represented. Original thoughts were these tools were modifications of the original double bitted form, where edges had become so worn that heavy modification was necessary. If the edges of these tools were recently modified or re-knapped, creating the distinct triangular edges then the hafting portions should be heavily worn. Micro analysis shows they have considerably more wear than originally hypothesized, especially around the bit edges and were likely used considerably prior to abandonment. Wear is consistent with that of the other tools in the archaeological collection. These tools have heavy areas of additive and abrasive wear. These tools have locations of multiple overlapping striations, suggesting multiple periods of use.

Bit Edge Wear on the Elongated Tools with Triangular Edges

The use-wear consists of microplating wear with heavy abrasion and overlapping striations (Figures 73 and 74). Striation wear is multi-directional with the majority running perpendicular, but numerous striations overlapping in varying directions.

Hafting Wear on Elongated Tools with Triangular Edges

Hafting wear on the tools in this category is consistent with that of the other tools in the archaeological collection, portions of heavy abrasion with the occasional location of striations (Figure 75).

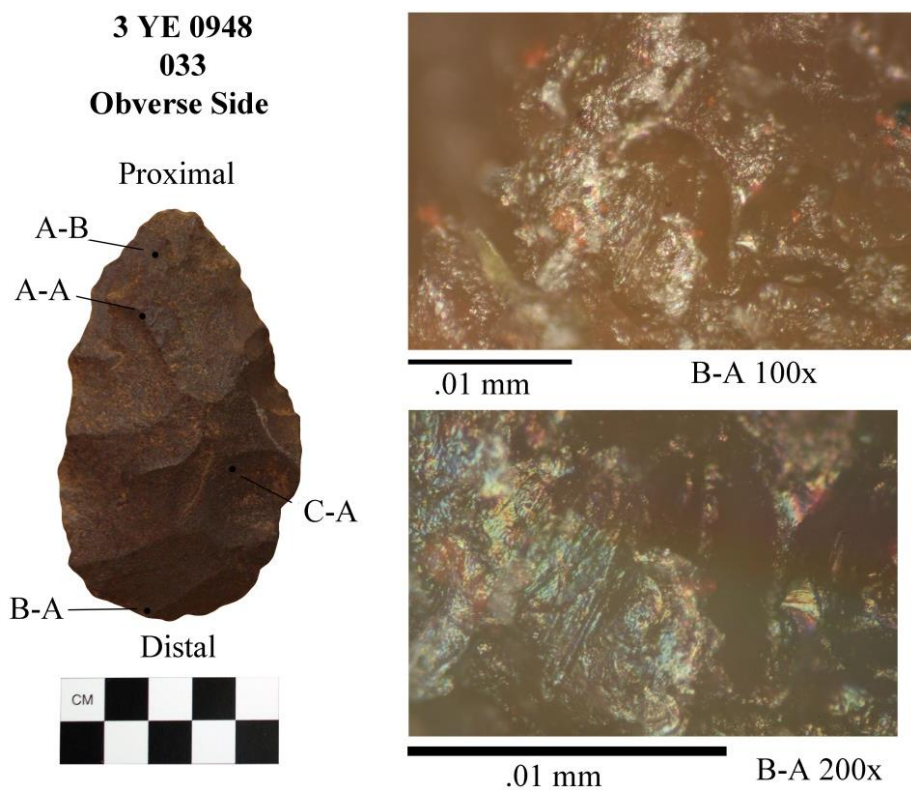


Figure 73. Bit edge wear on Artifact 033, Location B-A, showing abrasion of previous microplating and some striation wear.

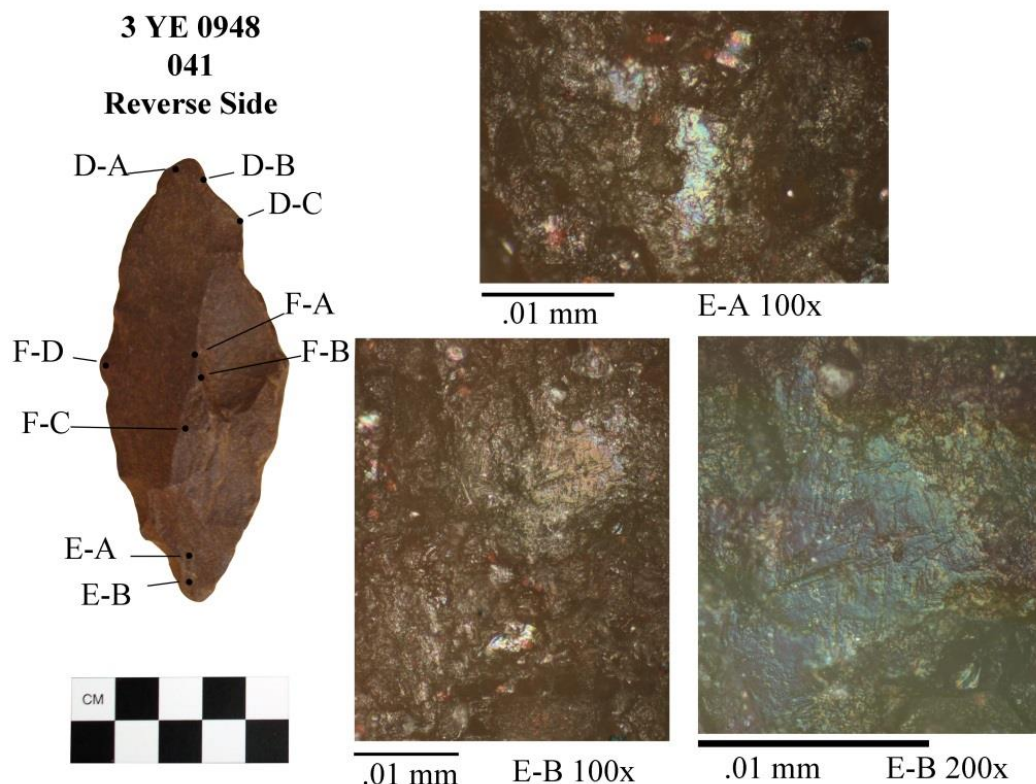


Figure 74. Bit edge wear on Artifact 041, Locations E-A and E-B, showing planes of abraded microplating and overlapping striation wear. Image also shows the generalized wear pattern on the bit edge of the elongated tools on Artifact 041, showing the distal edge to have substantial abrasive and additive wear. When compared to Figure 120, the differences in the bit edge wear on the elongated tools is clear.

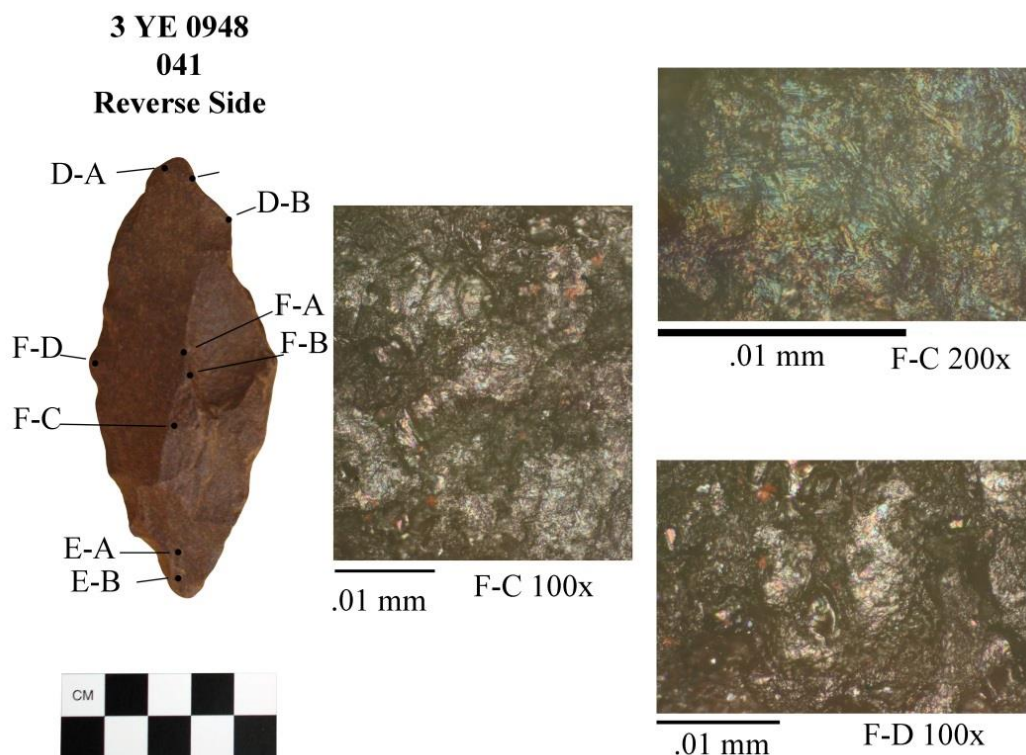


Figure 75. Hafting wear on Artifact 041, Locations F-C and F-D, showing abrasion and striation wear.

Elongated Tools with Rounded Edges

This category consists of three tools which were thought to be modified versions of the double bitted tools, and therefore have similar wear. Microanalysis shows these tools have substantial wear on both the bits and hafting portions. Large areas of polish can be seen, especially on Artifact 008. Wear is consistent with what is seen on other tools in the archaeological collection.

Bit Edge Wear on the Elongated Tools with Rounded Edges

The tools in this category have heavy multi-directional wear on the bits. Wear on the bit edges is expressed by large portions of abrasion with heavy multi-directional striations which run perpendicular, parallel and oblique to the bit edges (Figures 76-77). These tools show evidence of multiple periods of long term use.

Hafting Wear on Elongated Tools with Rounded Edges

Since these tools were thought to be modified versions of the double bitted form, the hafting wear was expected to be similar. Microscopically, the hafting wear on these tools is consistent within this category and within the archaeological collection. Wear includes heavy abrasion on previous microplating wear with locations of striations (Figures 78-79).

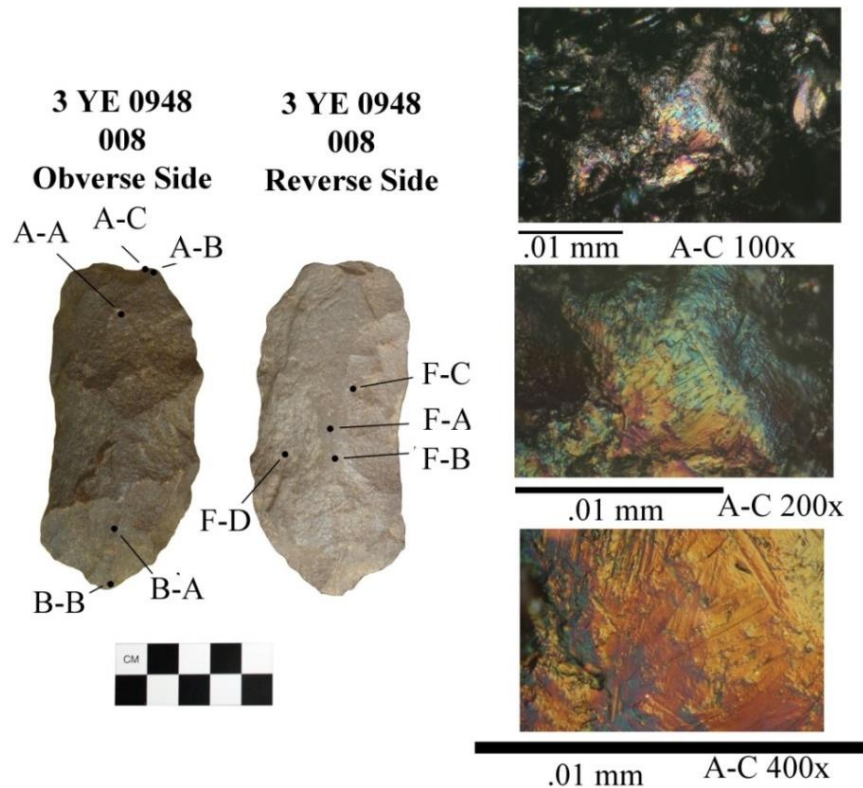


Figure 76. Bit edge wear on Artifact 008, Location A-C, showing large microplated planes with heavy abrasion and multi-directional striations. Image also shows generalized wear patterns on the bit edge of the elongated tools on Artifact 008 showing the proximal edge to have substantial abrasive and additive wear. When compared to Figure 121, the differences in the bit edge wear on the elongated tools are clear. Also when compared to wear seen in Figures 119 and 120, the different amount of wear seen between the triangular and the rounded edged tools.

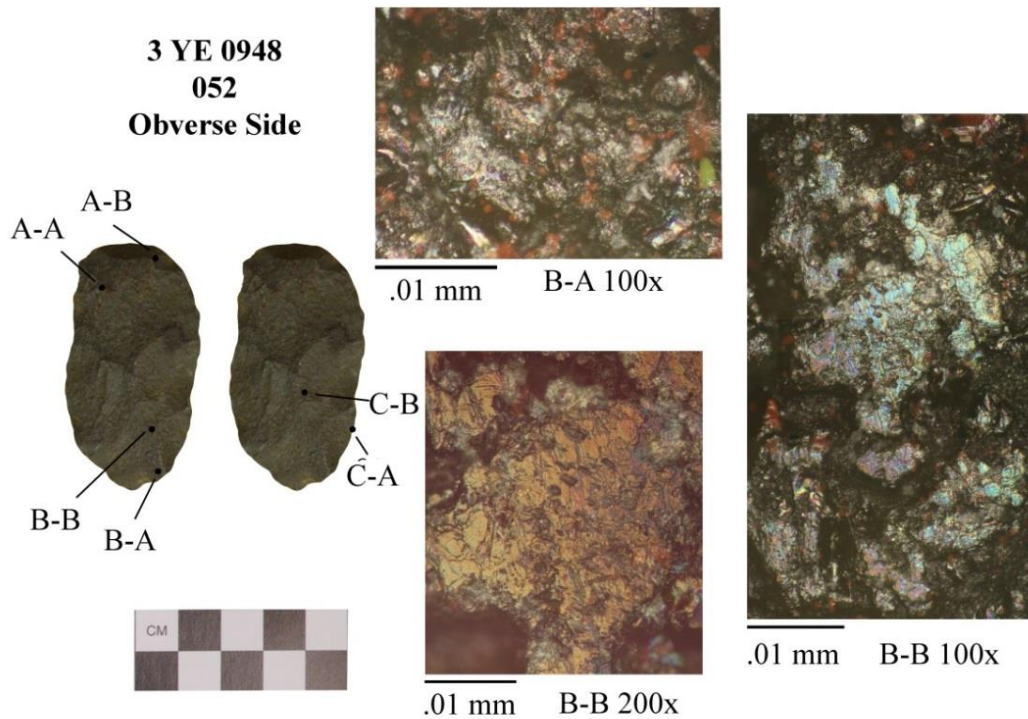


Figure 77. Bit edge use-wear on Artifact 052, Locations B-A and B-B, showing large microplated planes with heavy abrasion and multi-directional striations.

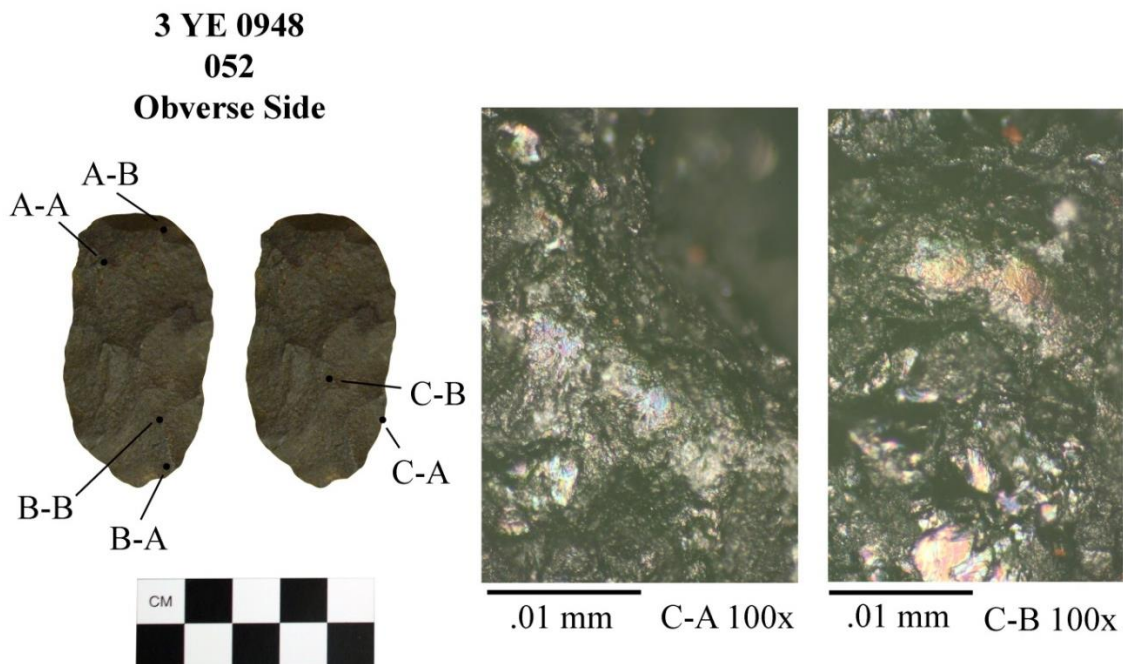


Figure 78. Hafting use-wear on Artifact 052, Locations C-A and C-B, showing abrasion and microplating wear.

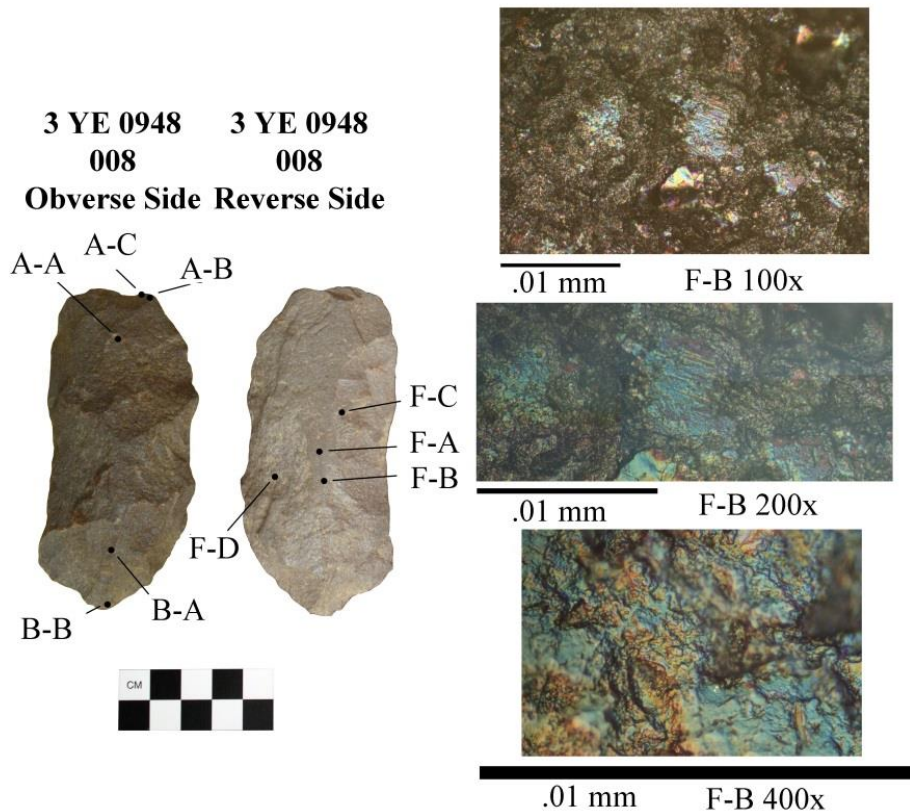


Figure 79. Hafting use- wear on Artifact 008, Location F-B, showing abrasion on previous microplated surfaces and minimal striations.

Damaged Tools

This category consists of 10 tools whose original form could not be determined. Most of these tools show the same wear seen on the rest of the archaeological collection. Wear seen is heavy abrasion with portions consisting of striations.

Bit Edge Wear on the Damaged Tools – Form Undetermined

Wear on these tools consists of heavy abrasion running perpendicular to the bit edge. Bit wear is similar to that seen on the other archaeological tools, which is not surprising since these are more than likely damaged double bitted forms (Figures 80-82). The majority of these tools show damage consistent with bending fractures suggesting failure during use.

Artifact 036, a damaged silicified sandstone tool, stands out due heavy abrasion of a microplated surface and numerous overlapping striations both oblique and perpendicular to the tools edge (Figures 83-85). The major areas of abrasion and heavy wear appear at the edge of the tool, and wear further back from the bit edge has standard smoothing abrasion.

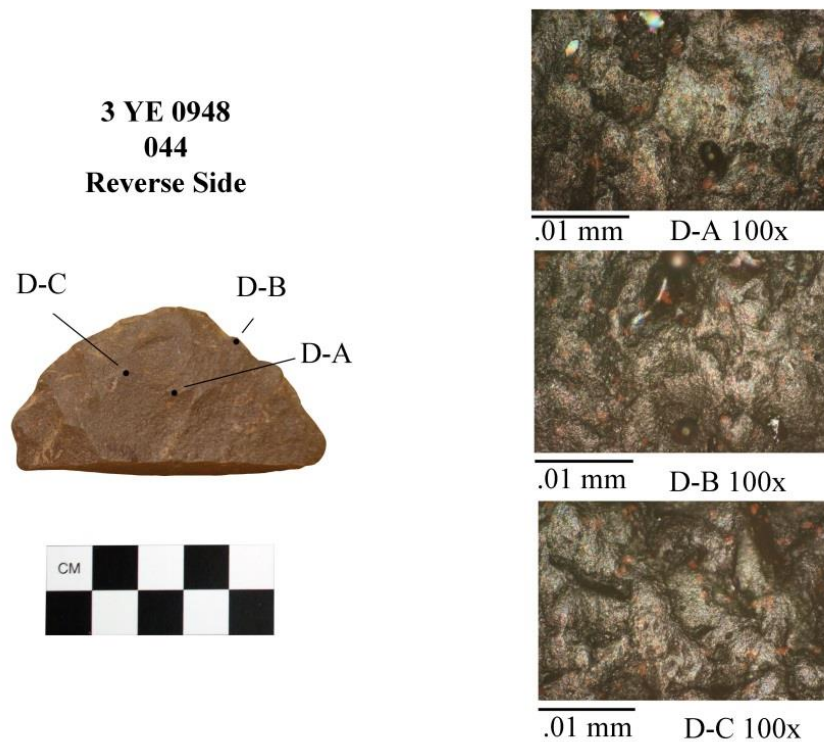


Figure 80. Bit edge wear on Artifact 044, Locations D-A, D-B and D-C, showing abrasion wear on a previous microplated surface.

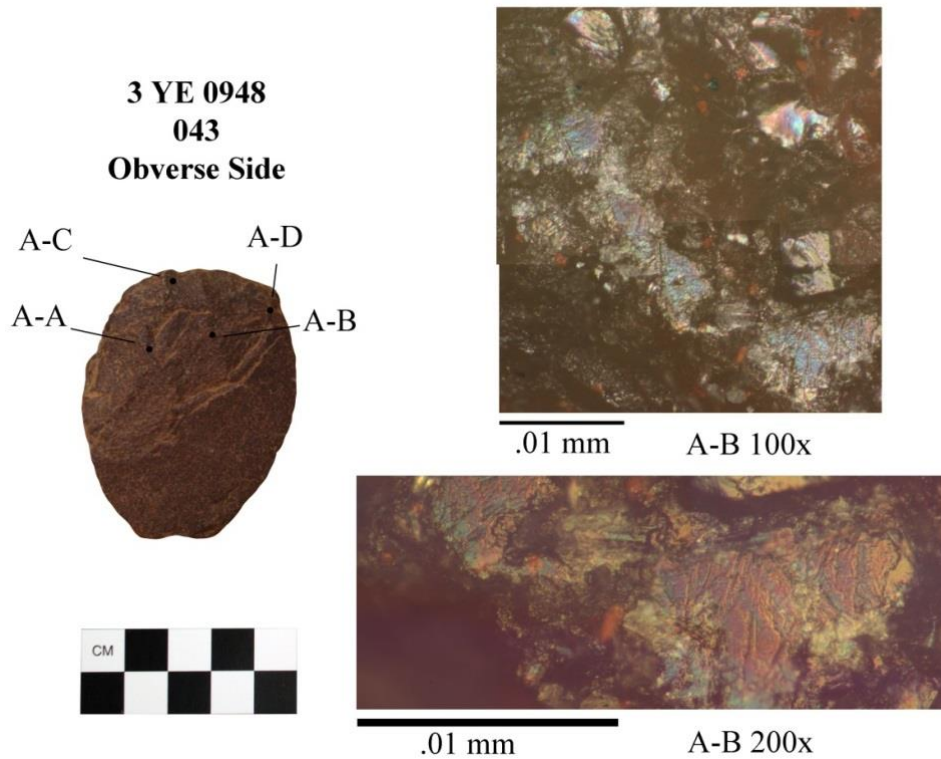


Figure 81. Bit edge use-wear on Artifact 043, Location A-B, showing additive and abrasive wear with oblique and perpendicular striations.

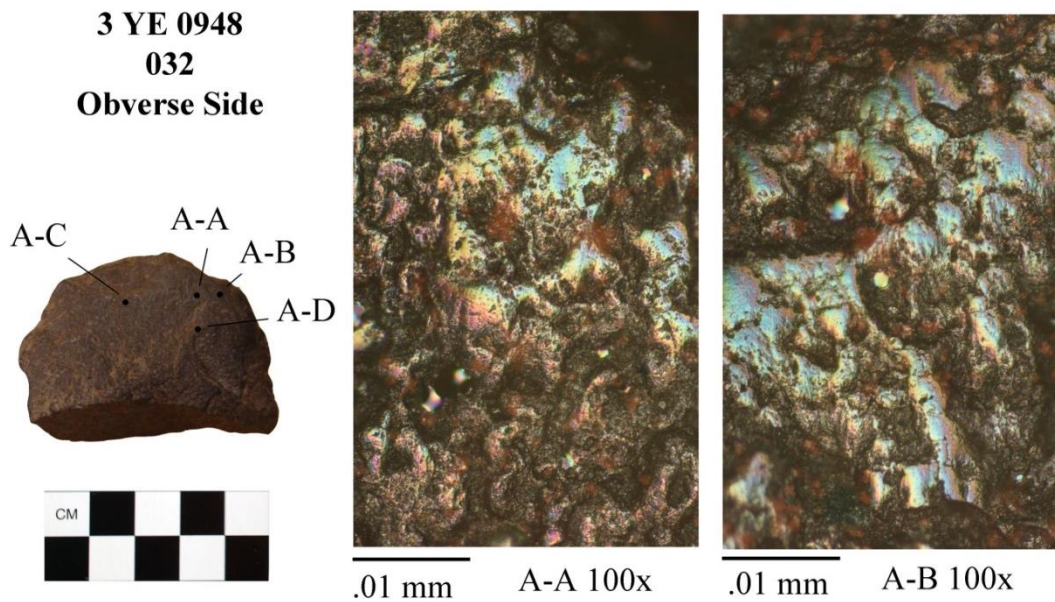


Figure 82. Bit edge wear on Artifact 032, Locations A-A and A-B, showing heavy abrasion of a previous microplated surface.

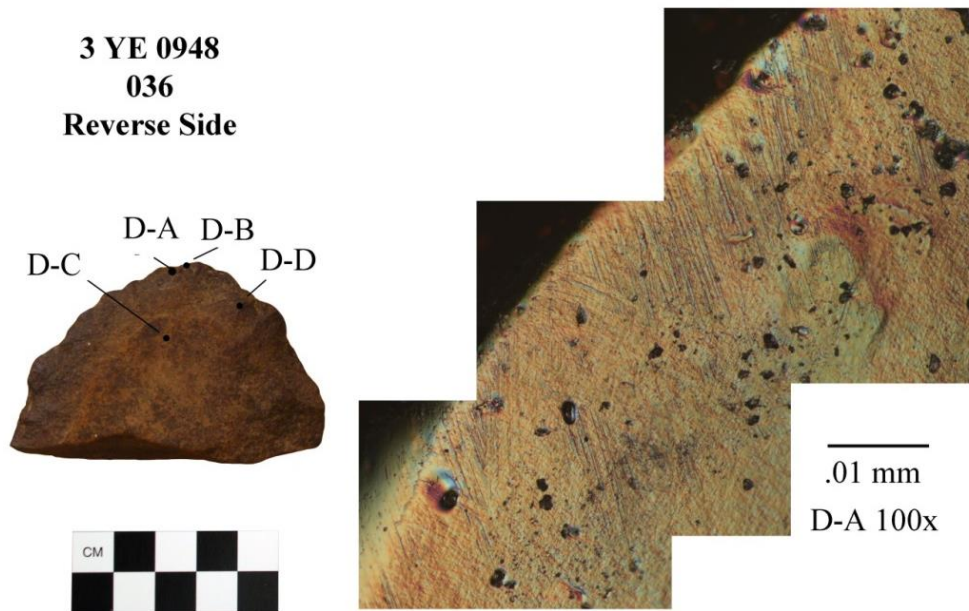


Figure 83. Bit edge wear on Artifact 036, Location D-A, showing heavy abrasion and multiple overlapping oblique and perpendicular striations.

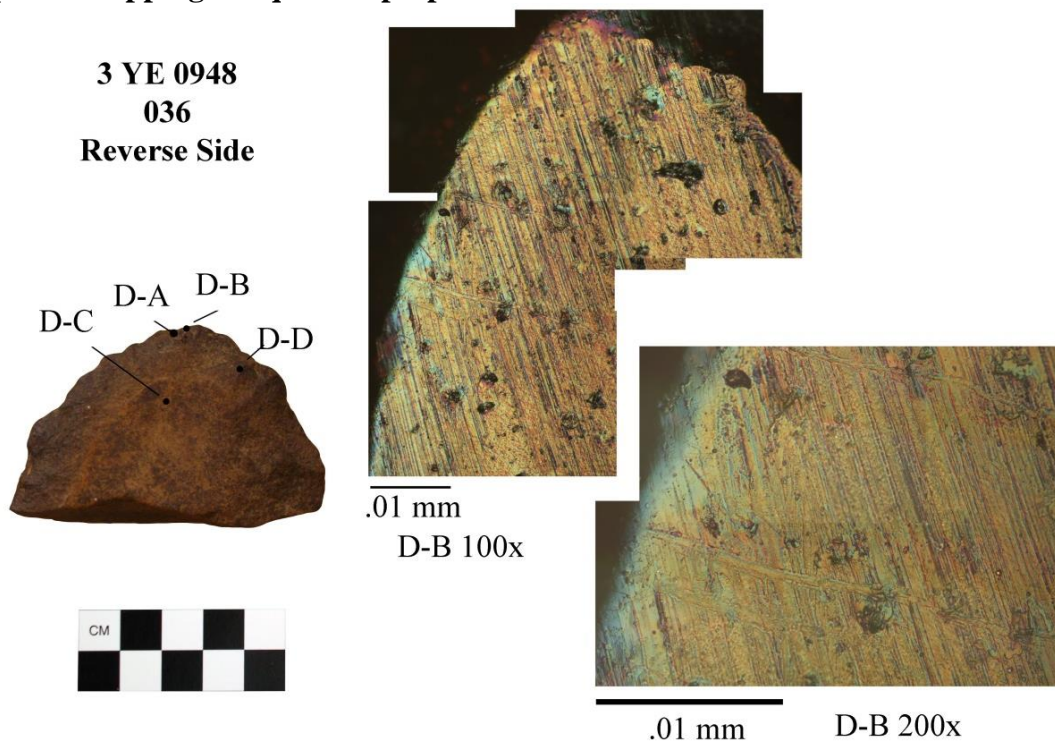


Figure 84. Bit edge wear on Artifact 036, Location D-B, showing heavy abrasion and multiple, overlapping striations which are both obliquely and parallel to bit edge.

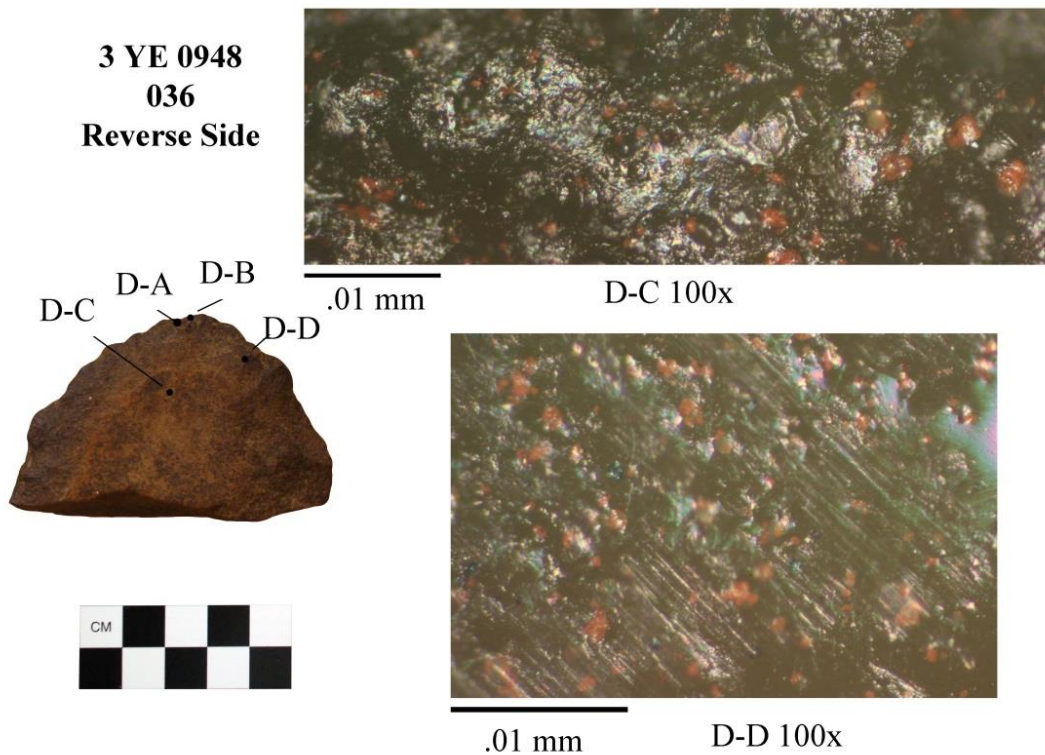


Figure 85. Bit edge wear on Artifact 036, Locations D-C and D-D, showing abraded surfaces and heavy striations.

Material Variation within the Collection

The Fourche Valley site collection offers the ability to look at the variation of tool material, since it has tools made of silicified sandstone, sandstone, slate and chert. The wear on the varying materials is similar in nature, with slight material specific differences.

Chert

Artifact 022 is made from chert has unique use-wear patterns unlike anything else in the collection (Figure 86 and 87). The wear is larger in scale and depth, potential due to the density of the chert compared to the silicified sandstone. The wear on this tool is still consistent with the other tools in the collection, just with greater abrasion and more striations. Artifact 022 has significantly different hafting wear (Figure 88). There are significant abrasions and striations

present both having a sharpness not seen on the tools made of silicified sandstone. Previous wear has been abraded down leaving linear portions of wear.

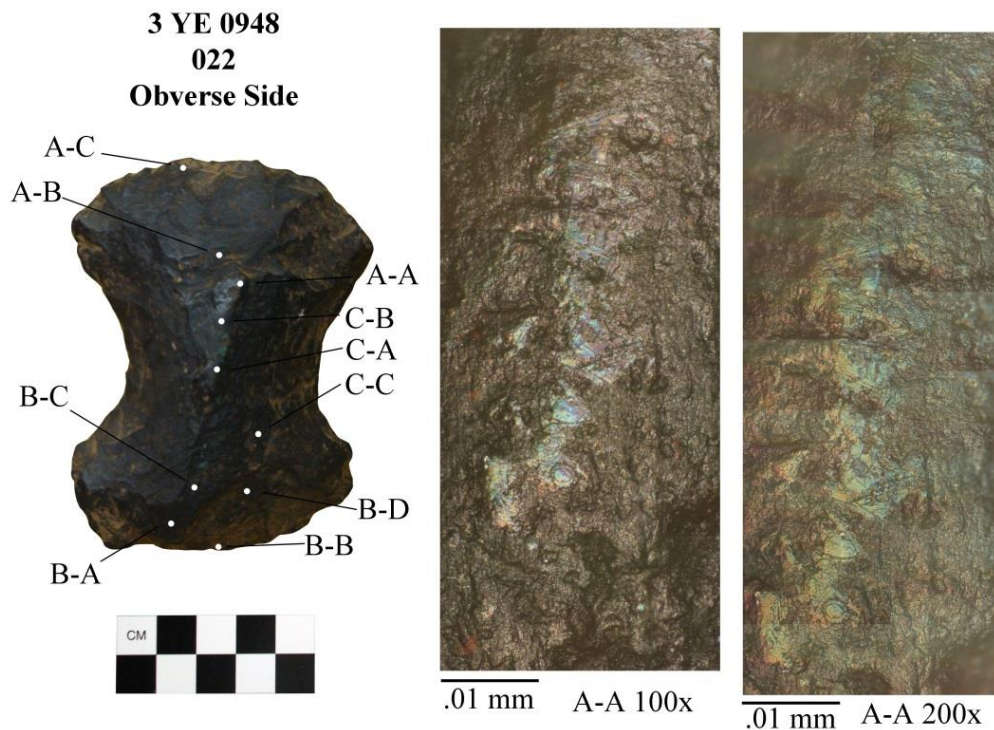


Figure 86. Abrasive wear on the bit edge of Artifact 022, Location A-A at magnifications of 100x and 200x. This tool is different from other tools in the collection since it is made of chert. Wear consists of heavy abrasion with additive microplating wear and multi-directional striations.



Figure 87. Abrasive wear on the bit edge of Artifact 022, Location A-A at magnification of 400x. This tool is different from other tools in the category since it is made from chert. Wear consists of heavy abrasion with additive microplating wear and multi-directional striations.



Figure 88. Hafting use-wear on Artifact 022, Location C-A. Wear on this tool is significantly different from the other tools in this category due to the material which it is made from, chert.

Sandstone

The sandstone artifacts have similar wear patterns as those seen in the rest of the collection with slight variations attributed to the material composition. The wear consists of large portions of generalized abrasion covering the surfaces of the tools (Figures 89 and 90). Microplating and striations are present, but with fewer locations than seen on the silicified sandstone.

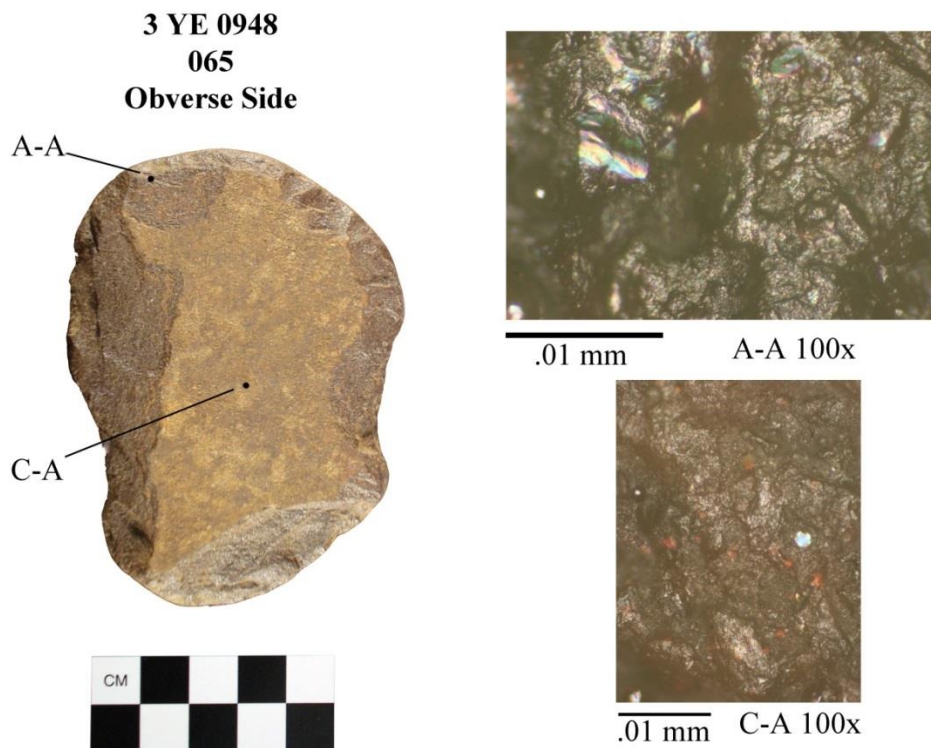


Figure 89. Bit and hafting use-wear sandstone Artifact 065, Locations A-A and C-A, showing generalized abrasion and fractured quartz grains.

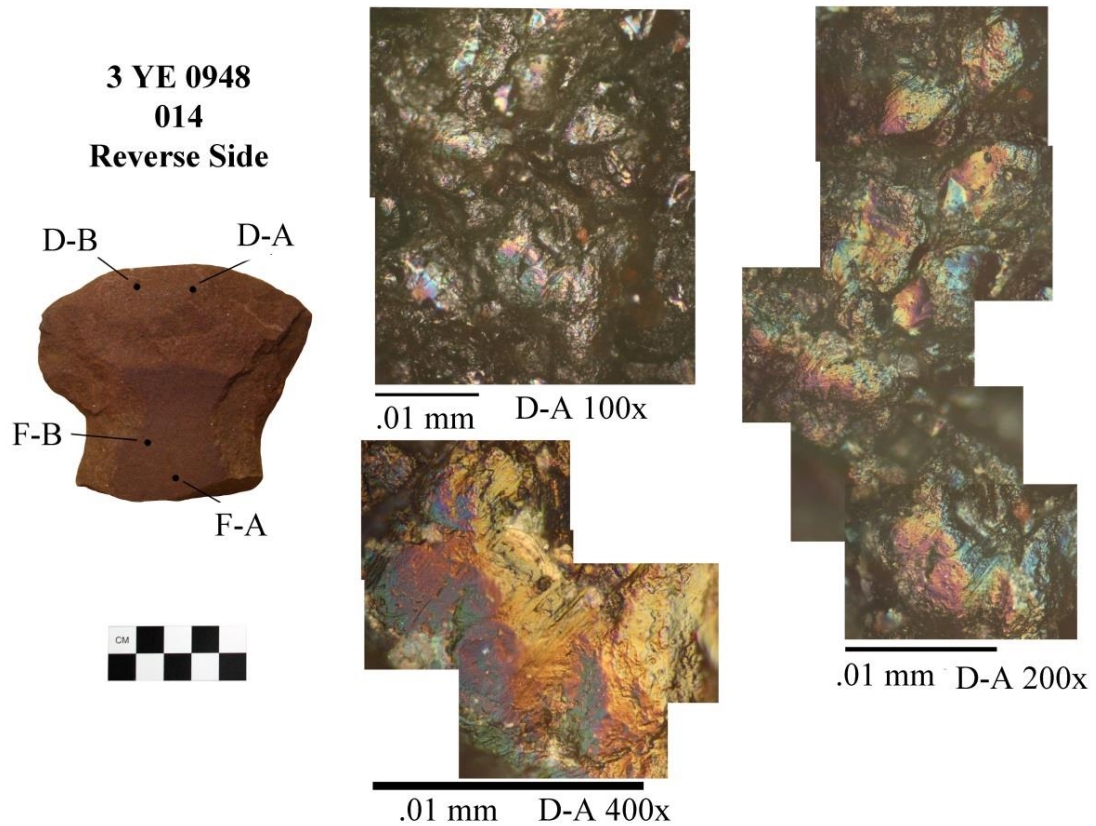


Figure 90. Bit edge wear on sandstone Artifact 014, Location D-A showing generalized abrasion and portions of microplating with directional striations.

Slate

The slate artifacts tend to have similar abrasive wear patterns (Figures 69 and 91). Neither artifact 040 nor 063 show any form of additive wear. The abrasive wear is light and generalized on the slate, but covers a majority of the tool surface.

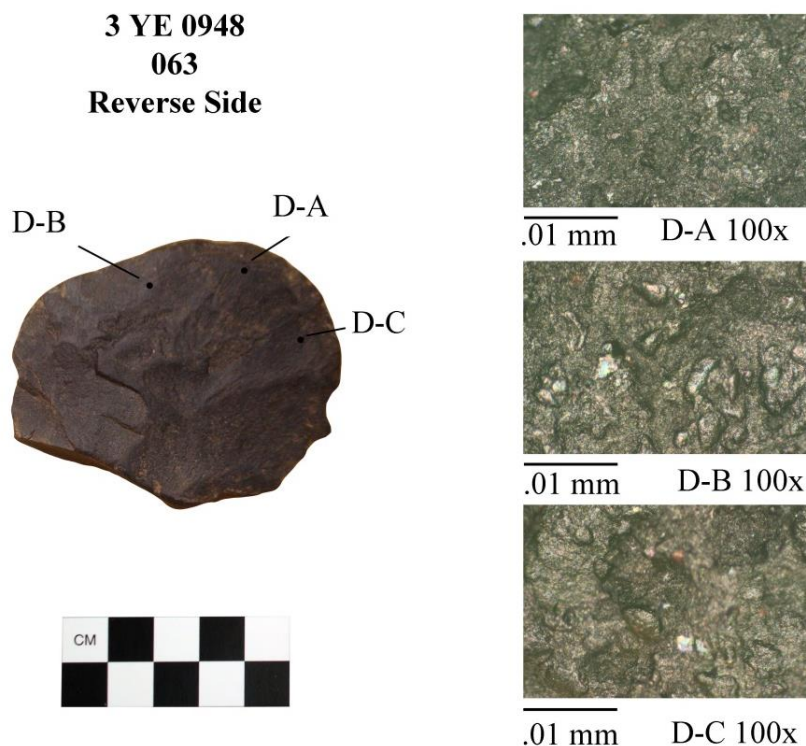


Figure 91. Use-wear on slate Artifact 063, showing light generalized abrasion.

Archaeological Collection Wear - Conclusions

While the use-wear of the archaeological collection is fairly similar in its basic form, there is variation between the different categories of tool form along the continuum of wear. This suggests that differing tool forms were potentially used for varying purposes.

The cycle of wear can be seen in the use-wear. Generally speaking wear begins with generalized abrasion. If tool use continues and contact with organic material is sustained, microplating additive wear begins to buildup on the tool, creating locations of layered harden silica gel. These locations expand with greater tool use. A second cycle of abrasion occurs if tool use is sustained seen as smoothing of the previously deposited microplating wear and the addition of striations. Both the smoothing and the striations increase in size and number through continued tool usage.

Interpretations of the Archaeological Collection

The Fourche Valley site archaeological collection has variation of tool form, size and damage, however, the use-wear seen on these tools is generally similar. There are differences between the form categories, however, it is limited and difficult to determine.

Bit wear seen on the archaeological collection generally consists of additive microplating wear with the presence of abrasive wear and striations usually running perpendicular to the tool edge. Wear on the bit edges of the tools is of similar depth and wear. This can be seen throughout the entire archaeological collection and on the individual tools as wear is usually consistent on both sides of the tools and if applicable, on both the proximal and distal edges.

Hafting wear on the archaeological collection was relatively similar with little variation. Wear on the hafting portions is generally both additive and abrasive, with directionality parallel to the longitudinal axis showing movement of the tools within the hafting. Some tools in the archaeological collection have significant striations on the hafting area documenting the presence of abrasive particles within the hafting.

Varying wear patterns can be seen in the different groups which were described in Chapter 2 and are discussed here. These are general observations and not every tool in each category will fit into this analysis, however, as stated earlier, the wear on these tools is a continuum with varying degrees along this scale. Some sample images will be used to show wear differences, for more illustrations of wear see earlier in Chapter 4 and Appendix 2.

Double Bitted Tools

The tools in the double bitted category have similar wear patterns, microplating additive wear with light abrasive and striation wear. There is however, difference in wear between the triangular and rounded shaped bits. Wear patterns are similar on both tool forms with each

having the presence of light generalized wear with portions of microplating and striations. However, the rounded edged tools have substantially more of this wear, with in larger portions of microplating covering more of the tool surface (Figures 92-93). The microplating on the rounded edged tools is smoothed to the point that the layering effects of this wear are almost worn away. The rounded edge double bitted tools also tend to have a greater number of striations present and they tend to run in similar direction, usually perpendicular to the bit edge.

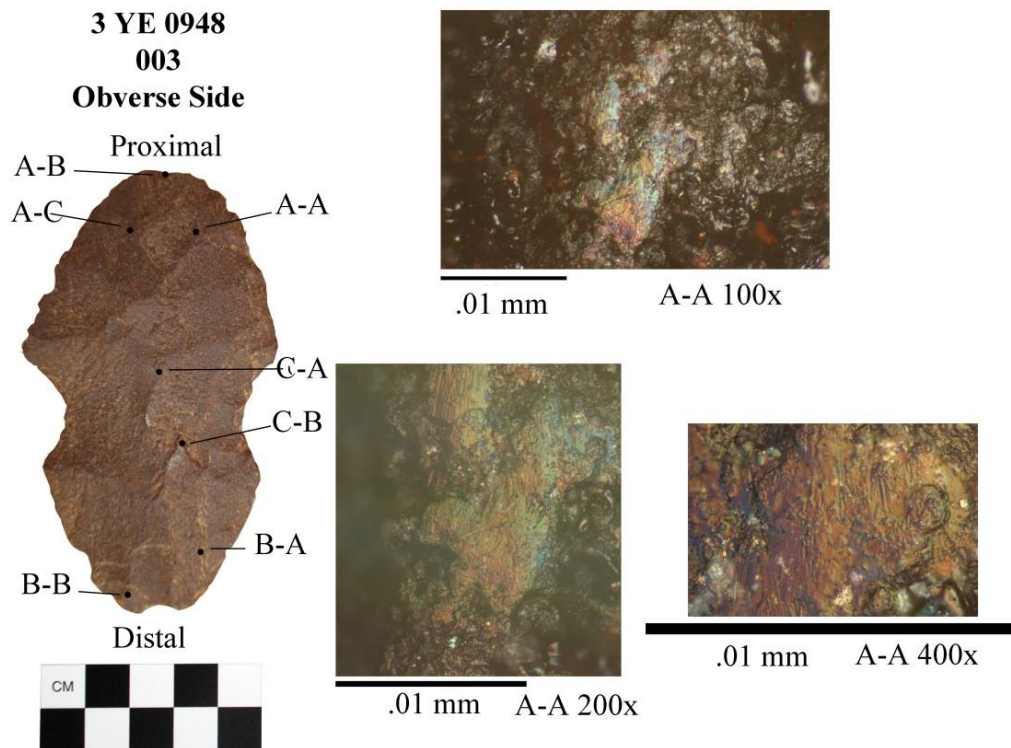


Figure 92. Generalized wear pattern seen on the bit of the triangular edged double bitted tools, on Artifact 003, showing microplating wear with generalized abrasion and light striations.

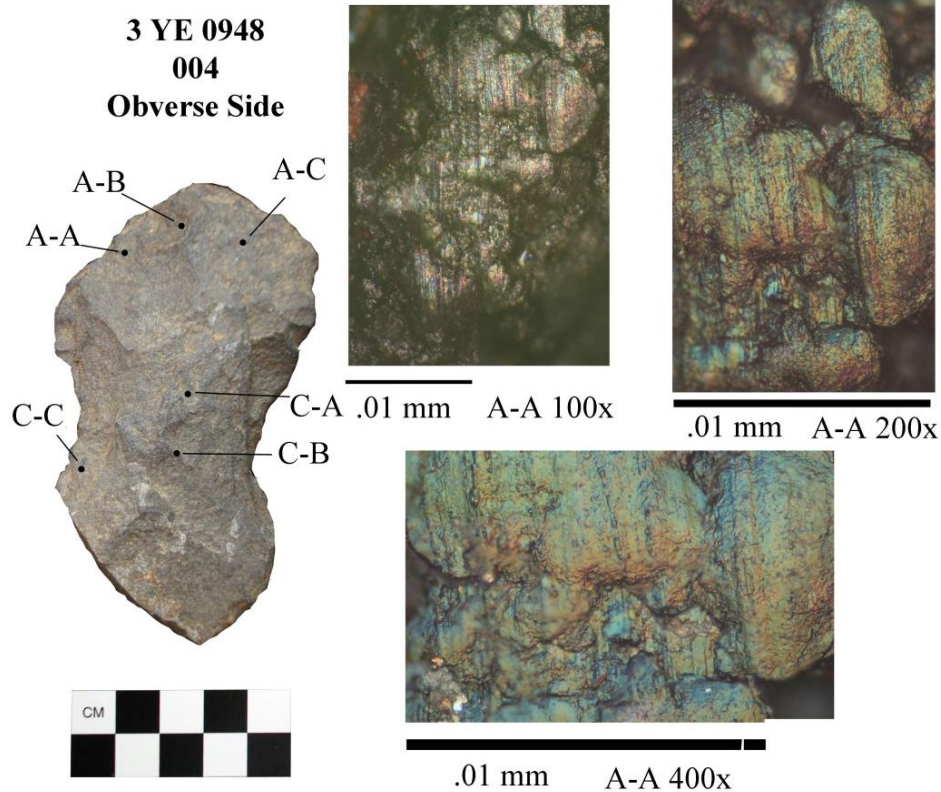


Figure 93. Generalized wear pattern seen on the bit of the rounded edge double bitted tools, on Artifact 004, showing similar microplating as seen on Artifact 003 (Figure 106), but with an additional smoothing abrasion occurring on top of the microplating wear. Striations also appear in significantly higher numbers and tend to run in the same general direction.

The differences in the wear patterns for the two forms of complete double bitted tools could be attributed to two factors: First, they were utilized for different purposes, and second, the differences are the visual representation of differences in length of time a tool is used. Based off of the tools themselves and the microscopic wear, the second explanation is the more likely. Since the wear is similar on both, with additional wear seen on the rounded edge tools, it is concluded that this additional wear is the result of additional use. If triangular edges were the original edge shape for this tool, it is a shape that is difficult to maintain through maintenance. Re-sharpening a triangular edge tool into a rounder edge would be the easier for continued

maintenance. Once the tool edge had been modified to a rounded edge, the ability to modify it a triangular shape would be extremely difficult.

Hafting wear follows the same pattern as the bit edge wear between triangular and rounded edged tools. Wear is similar, but the triangular edged tools tend to have smaller locations of microplating or generalized abrasion sometimes with heavy striations present (Figure 94). The rounded edged tools tend have large microplating locations with additional abrasive wear, creating large smooth planes that cover considerable portions of the hafting areas (Figure 95).

Just like the bit edge wear, this variation between the triangular and rounded edged tools is likely do to the length of use. The longer a tool was in contact with hafting material, the smoother the surface would be.

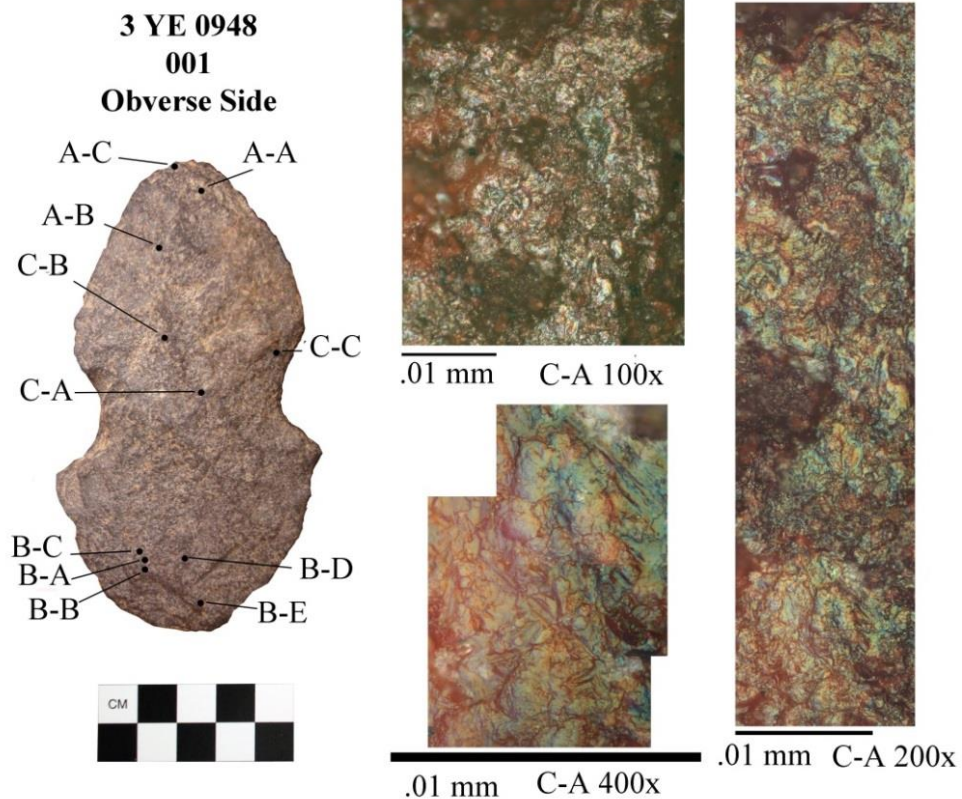


Figure 94. Generalized wear pattern on the hafting portion of the triangular edged double bitted tools, on Artifact 001, showing microplating and generalized abrasion with few striations present.

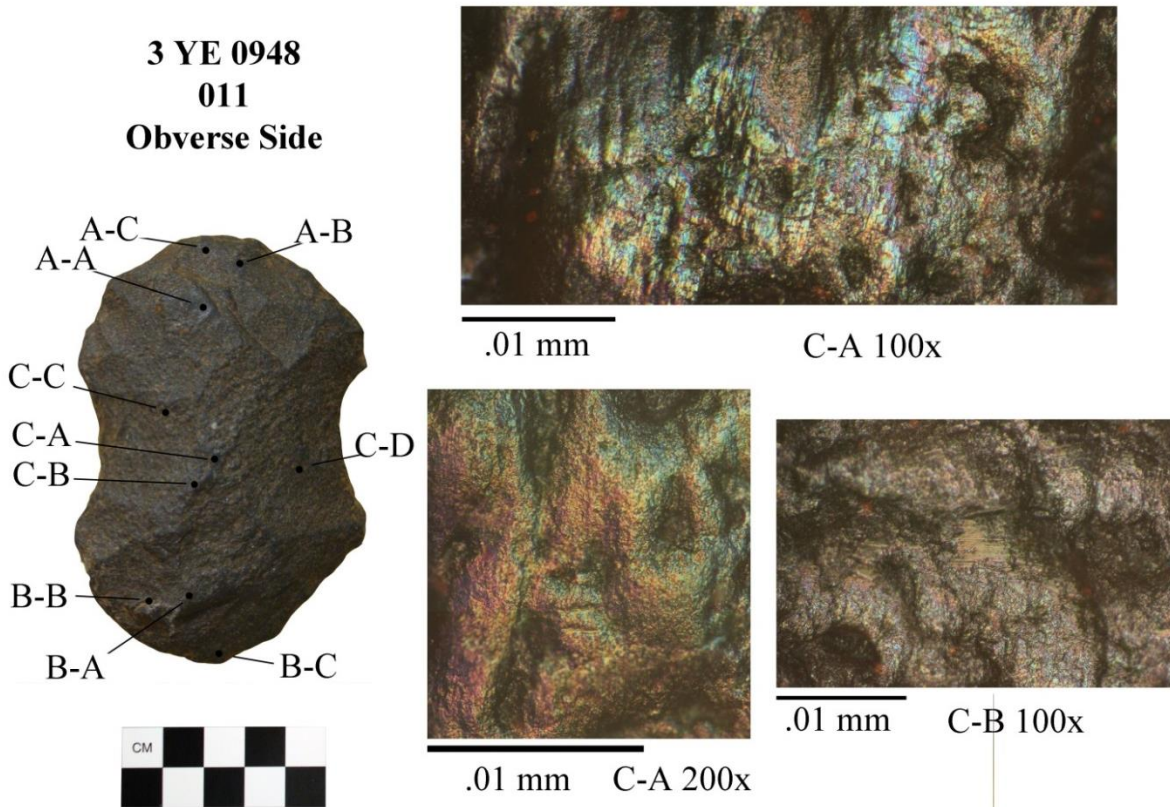


Figure 95. Generalized wear pattern on the hafting portion of the rounded edged double bitted tools, on Artifact 011, showing similar microplating wear as seen on Artifact 001 (Figure 94), but with additional abrasive wear on top of the microplating creating large plane like portions of smoothed wear.

Damaged Double Bitted Tools

These tools have wear similar to the rounded edged double bitted tools, which is not surprising as they are damaged portions of that form. Bit edge wear generally consists of heavily abraded microplating wear with striations running in similar directions (Figures 63-65). Hafting areas are also similar to the rounded edged double bitted tools, with large microplating wear with some additional smoothing abrasion (Figures 66-68). At least ten tools (50% of the category) of the damaged double bitted form have bending fractures where the tool failed, suggesting these tools broke during use.

Single Bitted Tools

These tools have similar wear patterns seen throughout the collection with slight variations. Even within this category, there appears to be two types of wear occurring. The first pattern is a heavy abrasive wear with few striations which is different from any of the wear seen previously in the collection (Figure 70). The second wear pattern is similar to the rounded double bitted wear, with even more substantial smoothing and covered in heavy multi-directional striation wear (Figure 96).

The haft wear on the single bit tools is different from the rest of the collection as these have less wear. The wear consists of generalized abrasion with little microplating seen (Figures 72 and 73) and is likely from a lack of tool movement within the haft.

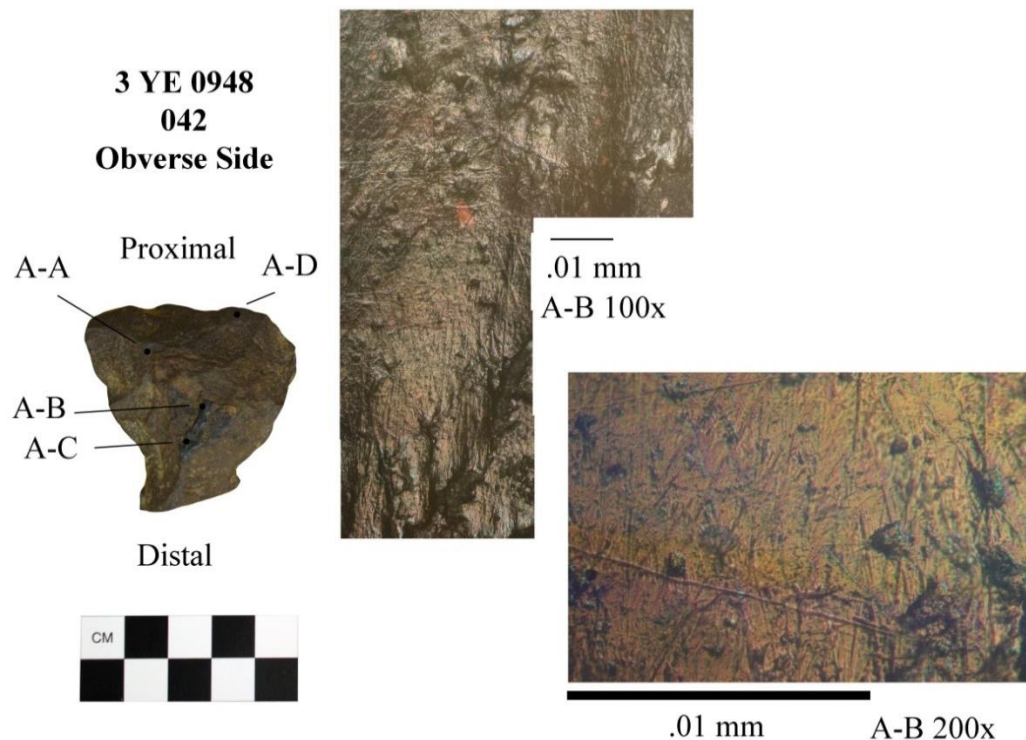


Figure 96. Generalized wear pattern on the bit of the single bitted tools, on Artifact 042, showing similar wear as the rounded double bitted tools, but with substantially greater smoothing wear and additional numerous multi-directional striations.

Elongated Tools

The wear seen on these tools is similar to the rest of the collection, but with varying placement of the wear, suggesting a different use of these tools. The tools in this group consistently have greater wear on one bit over the other. This varies from the rest of the collection which normally has the same wear on both bit ends. Wear on the heavy utilized edge of the elongated tools has heavy microplating with multi-directional striations (Figure 74), while wear on the opposite edge usually consists of generalized abrasion with little microplating (Figure 97).

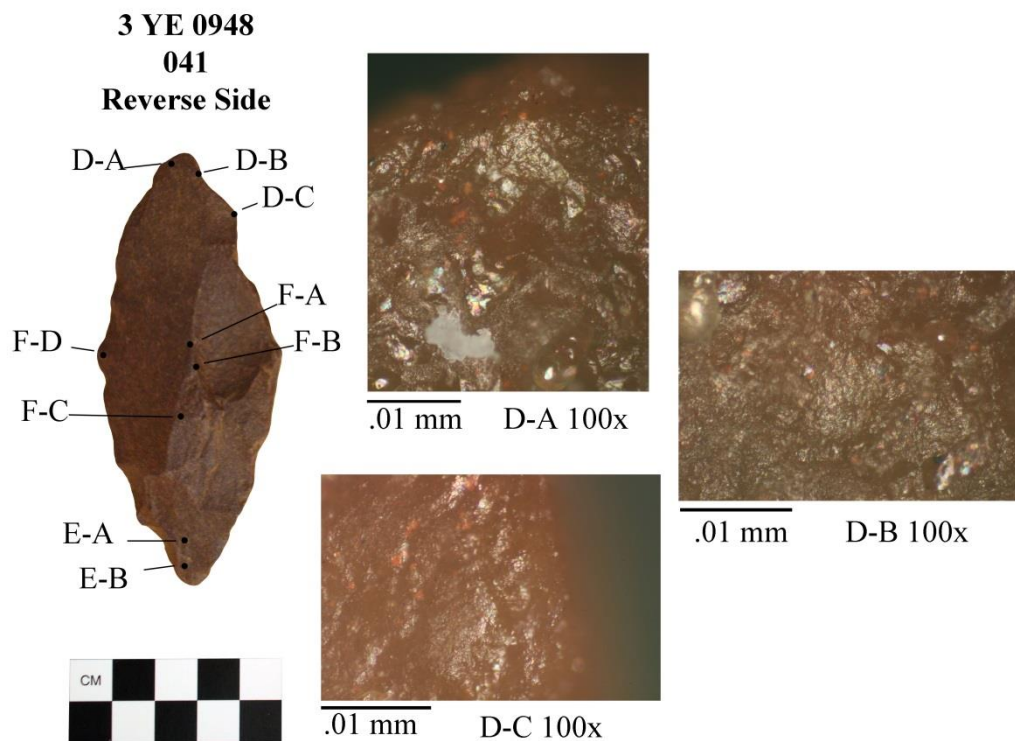


Figure 97. Generalized wear pattern on the bit edge of the elongated tools, on Artifact 041, showing the proximal edge to have only light generalized abrasion. When compared to Figure 74, the differences in bit edge wear on the elongated tools are clear.

A difference in bit edge wear is not seen anywhere else in the archaeological collection, and suggests these tools were utilized in a different way. Based off of the wear placement and the experimental work these appear to be agricultural tools likely hafted in an adze form. The tools edge which encounters the actual ground surface shows substantially more wear than the edge which is nestled in the handle.

The wear differences between the triangular edged and the rounded edged elongated tools reflect what was previously stated in the comparison of the double bitted tools. The elongated rounded edged tools have more wear than the triangular specimens, suggesting longer periods of use. Unique to the elongated tools however, is that even the rounded edged tools have one bit edge with substantially more wear than the other (Figures 76 and 98).

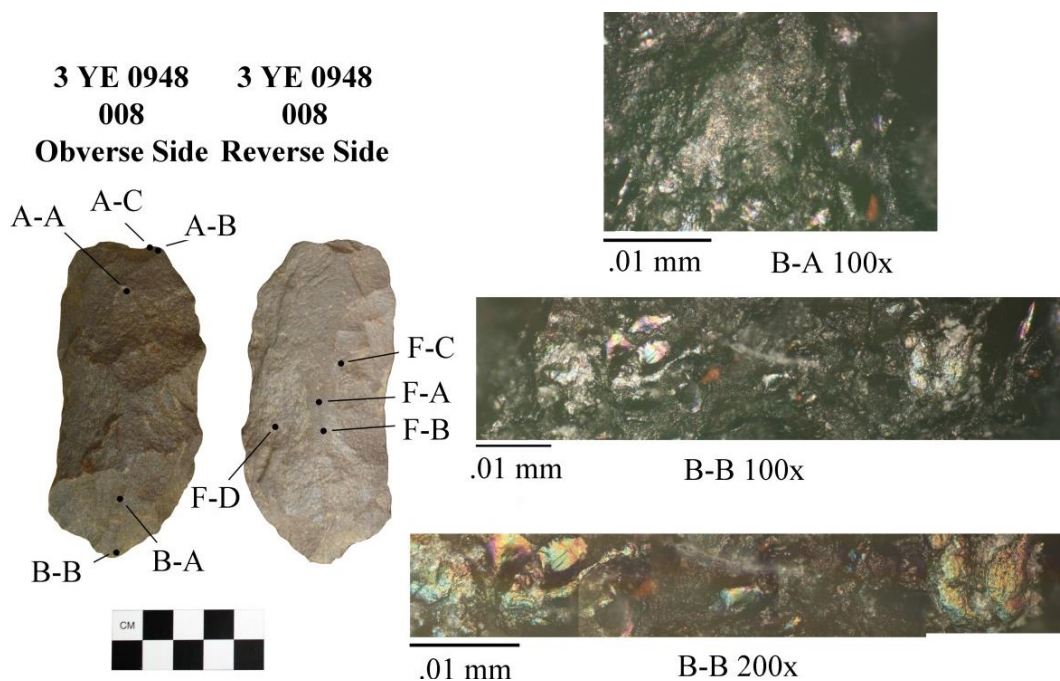


Figure 98. Generalized wear patterns on the bit edge of the elongated tools, on Artifact 008, showing the distal edge have to have light generalized abrasion with few locations of microplating and the presence of fractured quartz grains. When compared to Figure 76, the differences in the bit edge wear on the elongated tools are clear. Also when compared to wear seen in Figures 74 and 97, the different amount of wear seen between the triangular and the rounded edged tools.

Minimal variation of use-wear is seen on both the archaeological and experimental collections. Generally, the wear seen on the tools is fairly similar, consisting of abrasion, considerable amounts of additive microplating and additional abrasive wear. However, there is variation between the differing categories and variation of wear is seen tools made of on non-silicified sandstone.

V. Interpretation

Tools from the Fourche Valley site answer important questions about their use on this site and within Fourche Maline culture as a whole. The answers were not always the ones expected, but they do influence the knowledge about the people who made and used these tools. In returning to the original research questions, this chapter assesses the use-wear described in the previous chapter and what this might mean for the Fourche Valley site collection, the life cycle of these tools and the microscopic use-wear analysis process. The interpretation of the Practice Piece/Toy category will also be discussed.

Comparison of the Archaeological and the Experimental Collections

As stated above, the use-wear seen on the experimental collection (See Chapter 4 and Appendix 3) was similar in nature, with the bit wear generally consisting of additive microplating wear with some striations usually running perpendicular to the tool edge and hafting wear generally consisting of light abrasion and additive microplating wear. This continuum of wear seen on both the woodworking and agricultural tools in the experimental collection makes a differential analysis of the use-wear difficult.

One certain conclusion from the experimental replicas is these tools were not used in the processing of animal bone in any way. The tools used for this practice have a different use-wear pattern than the rest of the archaeological groups and the animal bone destroyed the stone tool and created damage not seen on any other in the archaeological collection (Figures 38 and 39).

The lack of obvious standardized differential wear between the woodworking and agricultural experimental tools leads to some problems when trying to compare the experimental replicas to that of the archaeological collection. The experimental groups re-created the wear which was seen on the archaeological collection and while lighter and less complex, the wear

patterns on the experimental replicas are similar with light abrasion present and the occurrence of additive wear and striations. While the experimental collection may not be able to definitively state the purpose of each individual tool, the continuum of wear does show differences in the categories of the tools and how they were likely utilized. The experimental field work also adds additional insight into the potential use of these tools.

Employing the use-wear on both the archaeological collection and the experimental replicas as well as the experimental field work, I am confident in the assertion that the double bitted form of tool was generally utilized as an agricultural hoe. The majority of the wear seen on the double bitted tool forms whether triangular or rounded edged or damaged tends to reflect the wear seen on the agricultural experimental replicas. When these tools were used in the field, the double bitted agricultural hoe replicas worked far better than those hafted as axes.

The single bit category is difficult to determine due to the variation seen in the grouping; however, the larger tear shaped single bitted tools, Artifacts 034 and 035, were most likely utilized as woodworking axes. The wear on the tip of these tools suggest a punch form hafting. The wear on these tools tends to be more abrasive in nature reflecting the wear seen on the woodworking experimental replicas. In the field, these tools performed quite well as axes and were able to fell trees of various sizes. The other tools in this group, Artifacts 039, 042 and 046 are more likely broken portions of a double bitted tool than a single bitted one. The wear on these tools is comparable to the double bitted form. Artifact 040 is a unique tool in this grouping as it is likely part of a grooved axe.

The elongated tool category appears to have been utilized as agricultural tools, likely punch hafted as an adze. The wear on these tools is different from the rest of the collection as the bit edges show differential wear patterns. The heavily used edges show wear which reflects

the experimental agricultural replicas, while the opposite edge shows lighter generalized abrasion, suggesting hafting wear. The experimental replica Scott County 02 was hafted and utilized as an agricultural adze and not only performed simple cultivation superbly, but the wear seen on this replica reflects wear on the elongated tools.

While these conclusions are based off of the majority of the tools, the use-wear seen on the archaeological collection and experimental replicas, and the hands on experience from the field, it should be stated that these tools were utilitarian in nature and do show a continuum of wear. Not all of the tools in each of category will coincide with these conclusions as these tools likely had multiple functions throughout their life-cycle.

Practice Piece or Toy Category

The practice piece or toy category is a unique group in the collection due to the size, form, material composition, and wear patterns of these tools. The presence of practice pieces or toys should be considered within an archaeological assemblage (Dawe 1997). Tools in archaeological collections which stand out due to significant differences in size and manufacture quality with questionable functionality could potentially represent the work of children or novices. Tool shape and size aside, these tools were still utilized, and being the minority form of the collection suggests they were not a form which was in great demand. These tools were not modified to the standard double bitted form, but were left rougher and chunkier, most likely due to the sandstone material from which they are composed.

The Fourche Valley tools in this group were likely created by individuals with little to no skill when it came to knapping or by children just learning this technique. The material used and the final tool form which resulted, are subpar when compared to the rest of the collection. These tools are made from sandstone and appear to be pieces of stone which just happened to be lying

around. Some of these tools still have cortex attached. The tools appear to be ground as opposed to knapped. The tools appear to be ground into the general double bitted form, but with little of effort put into creating the distinctive bit edges and hafting regions seen on the other tools.

While these pieces are most likely toys, many of them still show substantial wear. Dawe (1997: 314) argues that “toys are not merely replicas but are functional”, which is seen in this category, as these large sandstone tools do have significant wear. Wear on these tools is not consistent; some of the tools show substantial use-wear while others barely having even light abrasion (Figures 47-49 and 99-101). Based off of the use-wear and form these tool were likely utilized as agricultural hoes. Wear tends to have significant microplating usually with few multi-directional striations, some of which are partially filled in. Since these tools are usually quite thick and the edges blunt and roughly ground, they would not function well as woodworking tools, unless the goal was to slowly beat the wood into submission. As agricultural hoes these tools would function, though not to the quality of the silicified sandstone tools.

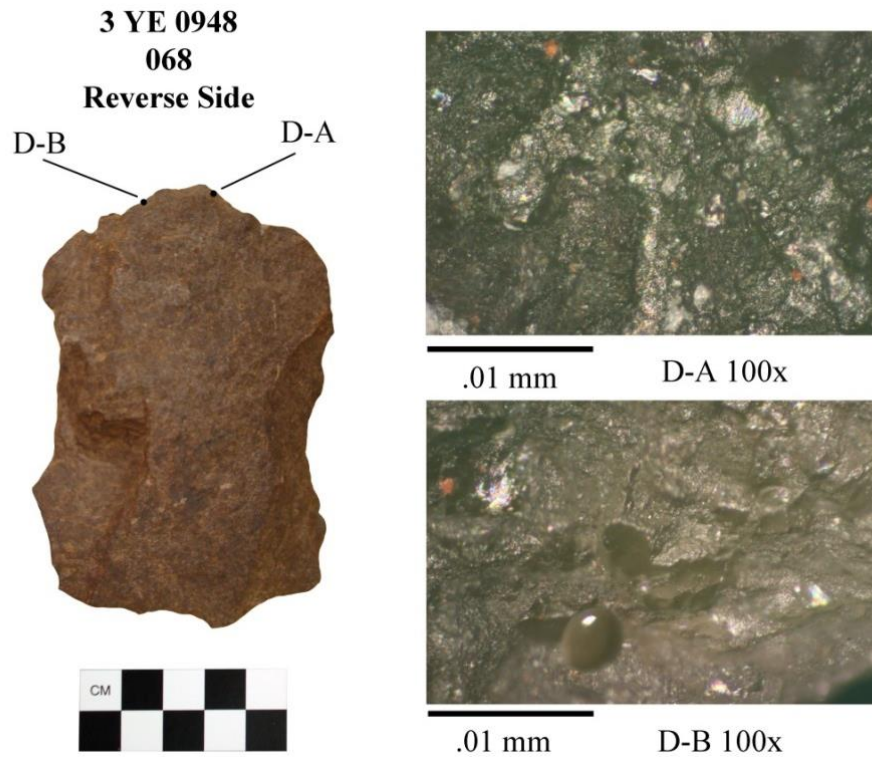


Figure 99. Light generalized abrasion found on Artifact 068 of the Practice Piece or Toy category.

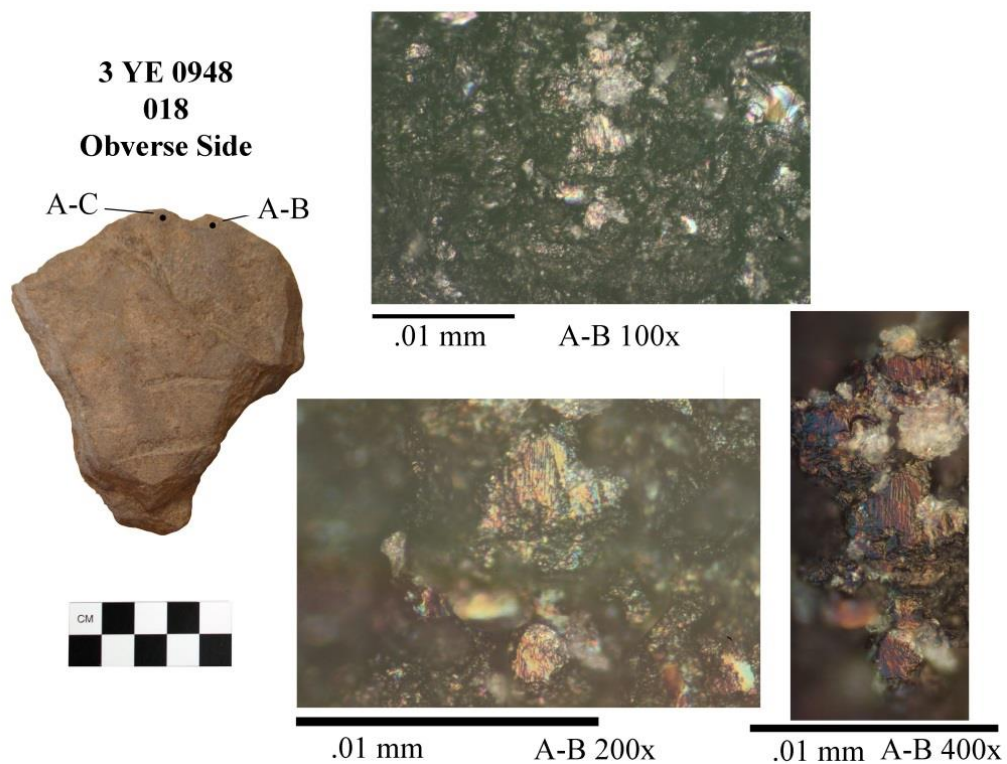


Figure 100. Light generalized abrasion with microplating wear on Artifact 018 of the Practice Piece or Toy Category.

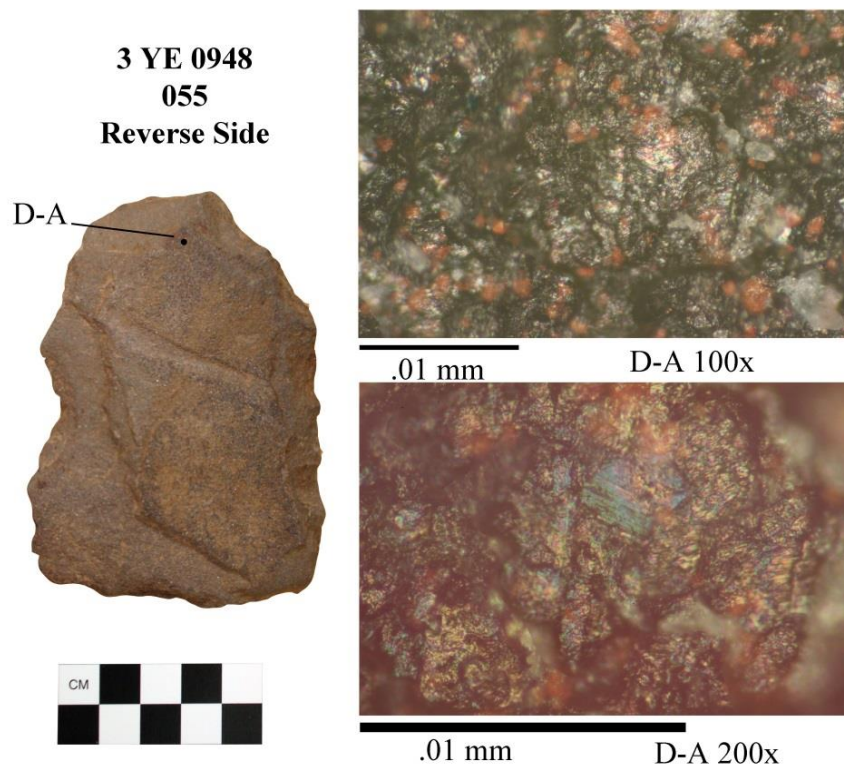


Figure 101. Generalized abrasive wear with the beginnings of microplating on Artifact 055 of the Practice Piece or Toy Category.

Length of Use

The Fourche Valley site archaeological collection has distinctive use-wear; however, it does generally lack in the amount of wear present especially when viewed at the macroscopic level. These tools generally do not have large portions of polish wear that would be expected on agricultural tools. It is clear the double bitted tools were utilitarian. There is an abundance of these tools at both this site and every Fourche Maline site in the region. The commonness of this tool implies the silicified sandstone material was readily available, and they were regularly knapped, used and discarded. Many of the tools in the collection are complete and would require little modification to be further used. A large percentage of the tools found were damaged suggesting this tool form may have a high failure rate, which could be the reason why they were

used and then quickly discarded. The majority of the damaged tools do not show additional wear from modified use after the critical damage occurred.

However, this does not mean these tools were completely disposable. The difference of the tool edge shape from triangular to rounded suggests some length of use, with at least a minimum of one period of re-sharpening. Some of the tools show significant grinding of the edge suggesting the intent of re-sharpening prior to abandonment. These tools were not instantly disposed of, some modifications were attempted.

The experimental collection showed how quickly microscopic wear appears on these tools. While the replicas were utilized for a substantial amount of time, we were not using them for everyday subsistence. Experimental use-wear was less complex than the archaeological collection; the wear is still similar suggesting the Fourche Valley collection was not utilized for long periods of time.

Tool Life Cycle of the Fourche Valley Archaeological Collection

One of the major research goals in this study was to determine the life cycle or production chain of the silicified double bitted tools. The splitting of the tools into different categories allowed patterns of production to be seen in the archaeological collection (Chapter 2). The assumption is made that the double bitted form is the original form which these tools were aiming to achieve.

With the exception of the practice piece/toy category, the variation of tool form in the archaeological collection was originally thought to be modifications of the double bitted form. The microscopic wear on the collection and the experimental field work showed the original hypothesis was likely incorrect. The variations in tool form were designed for distinct uses and were not simple modifications after double bitted tool damage.

The first form in tool production is the triangular edge double bitted tools. These tools have the sharpest, most defined edges and lighter in generalized wear. After periods of use and re-sharpening, the tool edges became rounder and smoother, creating the double bitted rounded tool category. This tool form has greater abrasive and additive wear. The double bitted tools are then used until damage renders them useless or until they are misplaced or discarded.

Single bitted tools were likely created specifically for use as axes and while these could have been modified from the double bitted form the use-wear on the tools does not show evidence of substantial modifications. The modification of these tools from the double bitted to the single would also be difficult as the tip end would be prone to breakage.

The elongated tool group potentially could have been originally double bitted in form having significant change in shape through use and modification. However, due to the substantial thickness in the central portion of these tools, it is unlikely that the double bitted form was the intended shape. While the purpose of the double bitted and the elongated tools are likely the same, the way in which these tools are utilized are different. The use-wear and the experimental field work shows distinct differences in how these tools would have been hafted.

The archaeological collection does show evidence of maintenance and recycling of tools. This is most easily seen on the damaged double bitted tools, three (5% of total collection) tools were utilized after damage occurred (Artifacts 015, 24 and 26). These tools were likely modified into a wedge like tool and show evidence of impact fractures on the damage edge (Figure 102). Artifact 058 shows evidence of maintenance (Figure 103) as the edges of the tool are ground down in preparation for re-sharpening of the tool edge. Tool failure most likely occurred during this attempt at maintenance.

Maintenance and use can be seen in the varying edge shapes on the tools. Use over time with the addition of re-sharpening episodes reduces the triangular shaped edges into the rounded smoother shaped tools.

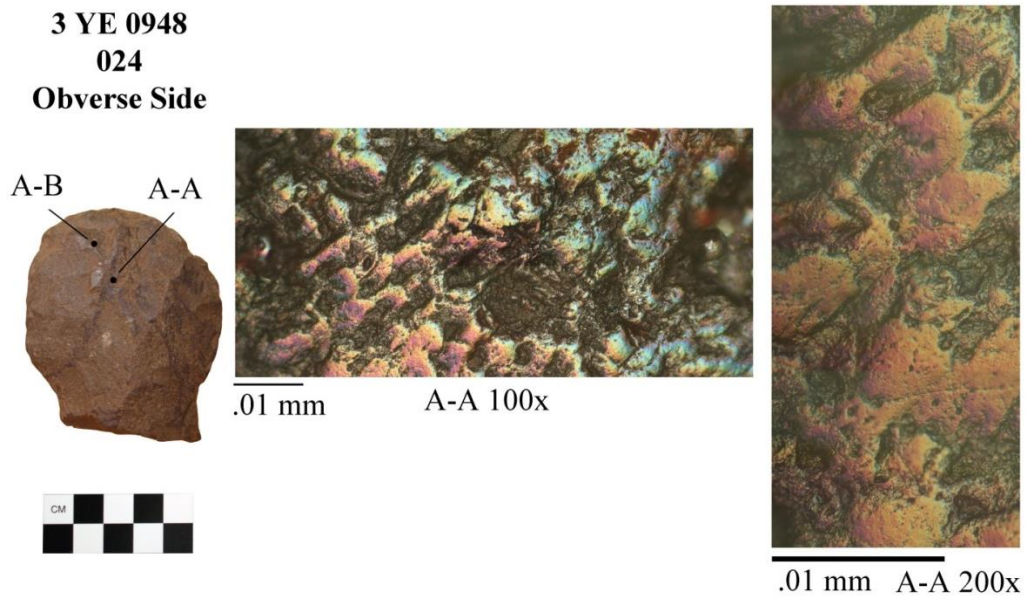


Figure 102. Artifact 024, a broken double bitted tool form which was recycled into a wedge tool. Impact fractures can be seen on the tool edge and wear is slightly different.

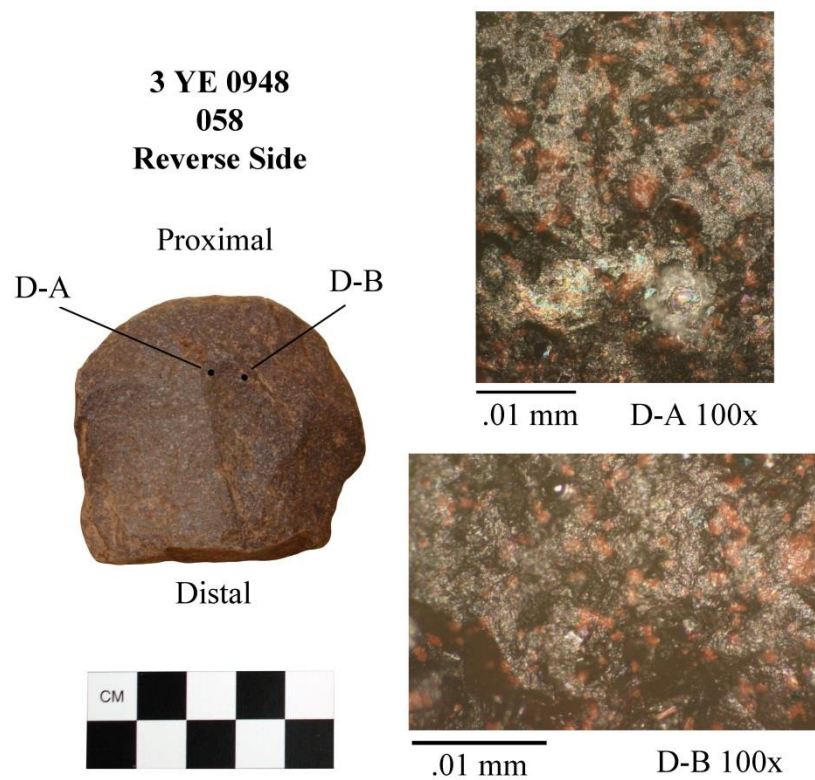


Figure 103. Artifact 058 with heavily ground edges in preparation of tool re-sharpening.

VI. Conclusions and Future Work

The purpose of this thesis was to answer questions associated with the double bitted tools from the Fourche Valley site and how these tools affected not only this site but all Fourche Maline sites in the Trans-Mississippian south. The outcome of this work has produced some interesting results, many of which were not original hypothesized. The large size of the Fourche Valley site collection allowed for an in-depth analysis which encompassed the variation of tool forms and the numerous amount of use-wear present. The creation of the Scott County experimental replicas provided the opportunity to have not only a comparative use-wear collection but also hands on field experience of potential use.

1. How accurate is the high resolution casting process for microscopic use-wear on non-chert prehistoric tools? What errors occur and how can these be avoided?

The casting procedure for this project reflects work done previously on stone tools from lithic collections all over the world, but is unique for this project since the majority of the tools were made from silicified sandstone. The casting procedure which was used in this study preformed excellently and exceeded expectations in its ability to replicate non-chert tool wear. The procedure utilized replicated wear in great detail with minimal error. While significant time is needed for such analysis, it is a necessary process for microscopic analysis due to the size of these tools. While errors in the casting did occur, simple adjustments to the process limit these errors and produce a superb result of tool wear replication.

2. How does the experimental use-wear compare with the archaeological collection? What does the experimental field work potentially show about the use of these tools?

The experimental collection played the major part in attempting to answer this rather simple question associated with these tools. However, as discussed in Chapter 4, what was a relatively simple question has a complicated and varying answer. Generally speaking the experimental work was able to show the likely functions of the overall categories of tools. As stated in Chapter 4, these conclusions do not answer the functionality of every individual tool, but they do provide the most functions for the majority of the tools in each category.

The experimental collection also had an impact on determining the length of time these tools may have been utilized. The double bitted silicified sandstone tools appear to have been utilized for shorter lengths of time than originally hypothesized. The tool form, the number of artifacts found, and the placement in the site suggest these tools were considered somewhat disposable. However, these tools were utilitarian and held value due to the modification and recycling practices in the form of edge grinding, bit re-sharpening and re-use of damaged tools. The action of re-sharpening these tools can be seen through edge reduction (triangular to rounded) variation seen in these differing tool edges. The experimental collection quickly replicated the wear seen on the archaeological collection, suggesting use-wear builds up quickly on the silicified sandstone material.

The experimental study provided knowledge of this collection through firsthand experience in the processing, creation and utilization of these stone tools. Using a varying tool forms, numerous types of hafting material and a collection of handles, the experimental collection showed which were had greater function along with the positives and negatives of each one.

3. What was the main purpose of these tools? Were they single- or multi-functional? Were these tools used extensively or were they disposed of after initial usage?

One of the main focuses of this work consisted of determining the function of the double bitted tools. The answer to this question is not a single one functional use, but a variation of uses based off of tool form and need. The tools in this collection are utilitarian in form and have a continuum of use-wear ranging from agricultural to woodworking with uses in between. While there is generalizing of wear, there are also distinct differences in the archaeological wear which are attributed to differing applications.

Schambach's hypothesis, stating the double bitted tools are more likely to be agricultural hoes than the axes for which they were named, was discussed in Chapter 1. Schambach based this hypothesis on the subsistence patterns of the Woodland time period. This study provides quantitative data which supports this theory for the majority of the tool forms in the Fourche Valley collection, specifically the double bitted and elongated categories. Through the use-wear analysis and the experimental field work, this thesis has concluded that the majority of the double bitted and elongated tool forms were utilized for agricultural practices, while the single bitted tool forms functioned as woodworking axes.

4. Do the tool forms serve separate purposes, or did modifications extend the life of the tool? Can the life cycle of these tools be reconstructed from the archaeological collection?

Differences in tool form do appear to have an effect on function. The tools in the Fourche Valley site collection have a continuum of wear and, generally speaking, the majority of the tools within a category can be associated with certain tool function. Based on the use-wear,

the experimental replica field work, and basic tool shapes, certain functional conclusions have been reached. The double bitted tool forms were utilized as agricultural hoes, the large single bitted tools are woodworking axes and the elongated tools are agricultural implements likely hafted as an adze. And while some tools may be further on the continuum of wear, the majority of the tools in each category fit these conclusions.

Tool edge shape does not appear to provide a different function for the individual tools, but does support a time line of use. Triangular edges are found on tools which have had a shorter length of use. As the triangular tools are used, both impact wear and re-sharpening activities transform the edges into the rounded form. The rounded edged tools are consistent in having more use-wear.

The life cycle of these tools can actually be seen in the collection. The first stages of the life cycle of the double bitted tools can easily be seen with the production of the triangular double bitted forms. Modification and use are represented in the collection both macro and microscopically and can be seen on the collection in the form of cleaning scrapes and grinding representing the sharpening of the tool edges. Recycling of the Fourche Valley collection can be seen in the modification of the damaged double bitted tools into wedge type tools. Determining a time for abandonment of these tools is difficult as many are still capable of functioning with little modification necessary and yet they constitute a large portion of the archaeological collection.

The practice piece or toy category is a unique feature to this collection as these tools likely represent the attempts of novices or children to create the double bitted form. This is factor in most archaeological site and lithic analysis which is overlooked.

.

Future work on the Double Bitted Tools

This thesis only presents a portion of the work which could be done with this collection or any collection consisting of the Fourche Maline double bitted tools. While the experimental collection was informative as to the analysis of the archaeological collection, further work could be done with it. The potential for additional information from the experimental group is quite high. Further work in the field with longer exposure to the varying contact materials could impact the types of wear seen microscopically. The same could be said about time of use for the hafting material. Many of the archaeological tools showed portions of hafting polish suggesting considerable abrasion in the hafting section and a longer use of the experimental group could potentially reflect this wear and possibly give greater insight into the types of binding which were utilized. The further work with the experimental collection could also benefit from the addition of re-sharpening or re-working the tool edges to see any potential effects this would have on the use-wear seen.

The information which was discovered in this thesis could also be compared to other Fourche Maline double bitted tool collections for additional insight in to the tools categories and to see if these groupings are site specific or are a constant in Fourche Maline collections. Further work with the practice piece or toy category of tools would also be beneficial. Focusing on this tool form through use-wear and experimentation could provide insight into the production and use of this unique set of tools.

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Appendix 1. Data Tables

3YE0948												
Inventory #	Weight (g)	Length (mm)	Max Width (mm)	Thickness (mm)	Proximal Blade Width (mm)	Proximal Blade Thickness (mm)	Distal Blade Width (mm)	Distal Blade Thickness (mm)	Hafting Width (mm)	Hafting Thickness (mm)	Tip width (mm)	Tip thickness (mm)
001	189.9	118.4	64.9	25.8	60.3	20.8	66.8	18.8	46.6	24.8		
002	99.2	90.5	55.0	18.0	51.5	17.8	55.0	15.1	44.2	18.0		
003	116.6	105.7	61.3	18.9	60.9	16.1	52.3	17.3	43.0	18.4		
004	142.5	102.0	58.3	22.4	58.4	20.5	49.5	17.3	40.0	18.4		
005	185.0	98.9	70.4	25.9	54.3	21.9	69.5	21.4	49.5	25.7		
006	132.8	101.7	55.3	26.5	51.4	15.8	54.9	25.5	41.9	21.1		
007	118.0	82.8	62.7	19.2	57.4	17.4	62.6	17.8	45.8	18.4		
008	167.6	100.0	47.6	33.9	49.2	23.1	46.0	31.6	42.3	33.6		
009	136.4	122.7	58.7	17.8	59.1	17.8	55.0	13.8	44.9	14.7		
010	155.0	91.8	72.1	30.0	66.5	17.8	71.9	22.9	58.0	23.9		
011	188.9	100.4	69.2	24.3	68.9	20.5	70.9	20.3	56.9	23.4		
012	157.5	101.2	63.3	23.8	61.0	18.5	63.6	22.9	43.6	21.91		
013	184.0	109.2	74.8	18.6	74.7	15.2	n/a	n/a	52.6	19.4		
014	226.8	80.6	93.9	24.6	93.8	23.6	n/a	n/a	58.3	24.8		
015	169.5	77.4	76.0	25.3	74.5	23.6	n/a	n/a	n/a	n/a		
016	270.6	83.8	71.0	31.8	71.7	30.5	n/a	n/a	n/a	n/a		
017	181.8	108.7	84.1	17.6	84.1	17.6	n/a	n/a	50.3	15.12		
018	200.4	101.2	93.2	19.4	95.4	19.2	n/a	n/a	n/a	n/a		
Not in Collection												
020	444.2	123.3	97.7	34.7	86.0	32.9	97.8	26.9	71.6	29.3		
Not in Collection												
022	165.7	91.0	71.2	25.1	71.9	17.0	68.0	24.1	45.4	25.1		

Table A-1, Part 1: Axe Database – Weights, measurements, material composition, tool form, and number of casts for each Fourche Valley artifact.

3YE0948				
Inventory #	Material	Tool Form	# of Casts	Hafting Present
001	SSS	Double Bitted - Triangular Edged	3	yes
002	SSS	Double Bitted - Rounded Edge	3	yes
003	SSS	Double Bitted - Triangular Edged	3	yes
004	SSS	Double Bitted - Rounded Edge	3	yes
005	SSS	Double Bitted - Rounded Edge	2	yes
006	SSS	Double Bitted - Rounded Edge	3	yes
007	SSS	Double Bitted - Rounded Edge	2	yes
008	SSS	Bifacial - Rounded Edge	3	yes
009	SSS	Double Bitted - Triangular Edged	3	yes
010	SSS	Double Bitted - Rounded Edge	3	yes
011	SSS	Double Bitted - Rounded Edge	3	yes
012	SSS	Double Bitted - Triangular edged	3	yes
013	Sandstone	Practice Piece/Toy	2	yes
014	Sandstone	Double Bitted Damaged	2	yes
015	SSS	Double Bitted Damaged	1	yes
016	SSS	Double Bitted Damaged	1	yes
017	Sandstone	Practice Piece/Toy	2	yes
018	SSS	Practice Piece/Toy	1	yes
020	Sandstone	Practice Piece/Toy	2	yes
022	Chert	Double Bitted - Rounded Edge	3	yes

Table A-1, Part 2: Axe Database – Weights, measurements, material composition, tool form, and number of casts for each Fourche Valley artifact.

3YE0948												
Inventory #	Weight (g)	Length (mm)	Max Width (mm)	Thickness (mm)	Proximal Blade Width (mm)	Proximal Blade Thickness (mm)	Distal Blade Width (mm)	Distal Blade Thickness (mm)	Hafting Width (mm)	Hafting Thickness (mm)	Tip width (mm)	Tip thickness (mm)
023	148.8	89.2	58.9	25.6	58.9	23.8	59.2	20.1	43.0	25.6		
024	157.2	80.9	65.9	27.4	66.5	21.5	n/a	n/a	46.0	26.1		
025	106.4	68.3	66.0	17.7	n/a	17.9	n/a	n/a	57.8	17.3		
026	119.8	72.5	63.5	22.5	63.8	22.2	n/a	n/a	54.7	18.5		
027	136.9	65.2	69.0	26.6	68.8	26.4	n/a	n/a	55.6	25.1		
028	146.3	66.6	70.9	27.9	70.5	27.6	n/a	n/a	50.0	26.1		
029	60.4	51.6	56.3	22.7	58.5	23.2	n/a	n/a	n/a	n/a		
030	97.1	89.5	66.5	17.1	66.3	16.3	5.9	17.6	48.2	15.7		
031	89.6	52.9	62.4	22.4	58.7	22.7	n/a	n/a	n/a	n/a		
032	45.4	42.2	56.0	19.7	56.3	19.5	n/a	n/a	n/a	n/a		
033	132.2	92.4	50.6	33.8	35.8	19.4	47.1	19.8	51.3	32.8		
034	72.5	75.6	51.3	24.4	50.4	22.9	n/a	n/a	n/a	n/a	22.29	12.63
035	154.2	89.3	63.3	38.6	61.6	34.4	n/a	n/a	n/a	n/a	24	12.73
036	71.9	46.2	74.8	17.2	74.5	17.3	n/a	n/a	n/a	n/a		
037	85.1	58.5	53.6	21.9	53.6	22.0	n/a	n/a	n/a	n/a		
038	54.5	36.7	56.0	23.3	57.4	24.4	n/a	n/a	n/a	m		
039	34.3	50.9	45.0	13.8	44.9	13.7	n/a	n/a	26.6	11.6		
040	93.6	67.0	51.4	23.8	51.2	23.9	n/a	n/a	41.3	n/a		
041	110.1	96.0	47.9	28.5	n/a	n/a	n/a	n/a	47.8	28.42		
042	52.7	46.8	49.6	21.7	48.4	21.8	n/a	n/a	n/a	n/a		
043	86.6	62.0	46.5	20.3	n/a	21.3	n/a	n/a	n/a	n/a		

Table A-1, Part 3: Axe Database – Weights, measurements, material composition, tool form, and number of casts for each Fourche Valley artifact.

3YE0948				
Inventory #	Material	Tool Form	# of Casts	Hafting Present
023	SSS	Double Bitted - Rounded Edge	3	yes
024	SSS	Double Bitted Damaged	1	yes
025	SSS	Double Bitted Damaged	2	yes
026	SSS	Double Bitted Damaged	2	yes
027	SSS	Double Bitted Damaged	2	yes
028	SSS	Double Bitted Damaged	1	yes
029	SSS	Double Bitted Damaged	1	yes
030	Sandstone	Practice Piece/Toy	2	yes
031	SSS	Damaged - Style Undetermined	1	no
032	SSS	Damaged - Style Undetermined	1	no
033	SSS	Bifacial - Triangular Edged	3	yes
034	SSS	Single Bitted	1	no
035	SSS	Single Bitted	2	no
036	SSS	Damaged - Style Undetermined	1	no
037	SSS	Double Bitted Damaged	1	yes
038	SSS	Damaged - Style Undetermined	1	no
039	SSS	Single Bitted	1	no
040	Slate	Single Bitted	1	no
041	SSS	Bifacial - Triangular Edged	3	yes
042	SSS	Single Bitted	1	no
043	SSS	Damaged - Style Undetermined	1	no

Table A-1, Part 4: Axe Database – Weights, measurements, material composition, tool form, and number of casts for each Fourche Valley artifact.

3YE0948												
Inventory #	Weight (g)	Length (mm)	Max Width (mm)	Thickness (mm)	Proximal Blade Width (mm)	Proximal Blade Thickness (mm)	Distal Blade Width (mm)	Distal Blade Thickness (mm)	Hafting Width (mm)	Hafting Thickness (mm)	Tip width (mm)	Tip thickness (mm)
044	47.1	35.6	67.9	16.7	67.5	16.3	n/a	n/a	n/a	n/a		
045	49.9	40.4	58.5	21.0	58.7	21.5	n/a	n/a	41.8	21.28		
046	37.3	50.8	38.0	20.3	38.4	20.0	n/a	n/a	n/a	n/a		
047	23.6	45.1	29.5	14.7	n/a	n/a	n/a	n/a	n/a	n/a		
048	44.3	61.0	39.0	17.2	n/a	n/a	n/a	n/a	n/a	n/a		
049	72.4	35.7	68.0	28.0	67.8	27.6	n/a	n/a	n/a	n/a		
050	28.2	29.6	54.4	16.7	54.3	16.6	n/a	n/a	n/a	n/a		
051	49.6	42.8	47.0	24.9	47.2	23.6	n/a	n/a	n/a	n/a		
052	29.4	58.0	31.0	15.3	n/a	n/a	n/a	n/a	29.2	15.34		
053	41.7	50.4	34.4	26.4	34.5	25.9	n/a	n/a	n/a	n/a		
054	Pottery											
055	181.4	97.5	71.4	19.1	52.6	17.0	n/a	n/a	62.3	19.2		
056	192.4	142.5	45.1	21.3	38.7	17.1	45.8	19.9	37.2	22.3		
057	129.2	69.9	60.0	22.1	n/a	n/a	n/a	n/a	43.7	27.98		
058	104.0	53.6	58.6	28.6	58.6	19.8	n/a	n/a	48.3	29.62		
059	103.3	68.2	56.0	22.6	56.4	23.0	n/a	n/a	47.2	21.7		

Table A-1, Part 5: Axe Database – Weights, measurements, material composition, tool form, and number of casts for each Fourche Valley artifact.

3YE0948				
Inventory #	Material	Tool Form	# of Casts	Hafting Present
044	SSS	Damaged - Style Undetermined	1	no
045	SSS	Double Bitted Damaged	2	yes
046	SSS	Single Bitted	1	no
047	SSS	Double Bitted Damaged	1	no
048	SSS	Double Bitted Damaged	1	yes
049	SSS	Damaged - Style Undetermined	1	no
050	SSS	Damaged - Style Undetermined	1	no
051	SSS	Damaged - Style Undetermined	1	no
052	SSS	Bifacial - Rounded Edge	3	yes
053	SSS	Bifacial - Rounded Edge	1	yes
055	Sandstone	Practice Piece/Toy	2	yes
056	Sandstone	Double Bitted Damaged	1	yes
057	SSS	Double Bitted Damaged	1	yes
058	SSS	Double Bitted Damaged	1	yes
059	SSS	Double Bitted Damaged	1	yes

Table A-1, Part 6: Axe Database – Weights, measurements, material composition, tool form, and number of casts for each Fourche Valley artifact.

3YE0948												
Inventory #	Weight (g)	Length (mm)	Max Width (mm)	Thickness (mm)	Proximal Blade Width (mm)	Proximal Blade Thickness (mm)	Distal Blade Width (mm)	Distal Blade Thickness (mm)	Hafting Width (mm)	Hafting Thickness (mm)	Tip width (mm)	Tip thickness (mm)
060	128.9	66.8	84.7	17.6	84.7	14.3	n/a	n/a	68.4	17.5		
061	143.1	110.3	65.1	20.8	64.7	21.1	58.3	16.4	44.5	20.71		
062	354.1	135.9	90.0	20.4	92.6	19.2	90.1	18.4	79.5	19.56		
063	86.1	67.2	70.8	17.5	71.2	16.6	n/a	n/a	60.1	18.14		
064	102.4	48.4	78.0	20.6	n/a	n/a	n/a	n/a	n/a	n/a		
065	156.8	89.5	66.7	18.0	66.7	17.2	n/a	n/a	57.7	16.97		
066	93.0	61.9	74.7	18.4	75.1	17.2	n/a	n/a	n/a	n/a		
067	88.9	93.9	51.8	17.3	55.6	15.3	49.3	16.2	43.6	17.0		
068	271.3	99.8	72.9	33.8	66.8	28.1	n/a	n/a	58.6	33.57		

Table A-1, Part 7: Axe Database – Weights, measurements, material composition, tool form, and number of casts for each Fourche Valley artifact.

3YE0948				
Inventory #	Material	Tool Form	# of Casts	Hafting Present
060	Sandstone	Double Bitted Damaged	2	yes
061	SSS	Double Bitted - Triangular Edged	3	yes
062	Sandstone	Practice Piece/Toy	1	yes
063	Slate	Double Bitted Damaged	1	yes
064	SSS	Damaged - Style Undetermined	1	no
065	Sandstone	Double Bitted - Rounded Edged	2	yes
066	SSS	Double Bitted Damaged	1	yes
067	SSS	Double Bitted - Rounded Edged	3	yes
068	SSS	Practice Piece/Toy	2	yes

Table A-1, Part 8: Axe Database – Weights, measurements, material composition, tool form, and number of casts for each Fourche Valley artifact.

Artifact #	Cast #	Location code	Location	Batch #	Length (mm)	Width (mm)
001	1	A	Obverse Proximal	Batch 9	34.02	36.52
	2	B	Obverse Distal	Batch 10	31.77	32.14
	3	C	Obverse Haft	Batch 12	51.52	34.07
002	4	A	Obverse Proximal	Batch 13	25.37	39.18
	5	B	Obverse Distal	Batch 9	33.1	32.14
	6	F	Reverse Haft	Batch 8	43.36	23.01
003	7	A	Obverse Proximal	Batch 11	31.04	36.88
	8	B	Obverse Distal	Batch 9	29.74	33.68
	9	C	Obverse Haft	Batch 7	42.78	37.45
004	10	A	Obverse Proximal	Batch 9	36.04	44.78
	11	C	Partial Haft	Batch 12	25.7	30.52
	12	C	Obverse Haft	Batch 8	38.06	27.26
005	13	D	Reverse Proximal	Batch 5	22.92	37.44
	14	F	Reverse Haft	Batch 6	49.94	37.5
006	15	D	Reverse Proximal	Batch 7	28.58	41
	16	E	Reverse Distal	Batch 11	25.79	37.9
	17	F	Reverse Haft	Batch 12	44.71	30.94
007	18	A	Obverse Proximal	Batch 5	33.33	41.8
	19	F	Reverse Haft	Batch 8	50.44	32.4
008	20	A	Obverse Proximal	Batch 3	26.35	40.77
	21	B	Obverse Distal	Batch 2	27.12	36.35
	22	F	Reverse Haft	Batch 8	40.82	38
009	23	D	Reverse Proximal	Batch 12	34.57	42.06
	24	E	Reverse Distal	Batch 9	29.73	35.32
	25	F	Reverse Haft	Batch 7	44.48	35.48
010	26	D	Reverse Proximal	Batch 2	27.01	46.79
	27	E	Reverse Distal	Batch 2	21.5	36.13
	28	F	Reverse Haft	Batch 10	62.5	33.41

Table A-2. Part 1: Showing individual cast numbers, casting codes, casting locations, batches which the casts were made from, and the individual cast measurements for each Fourche Valley artifact.

Artifact #	Cast #	Location code	Location	Batch #	Length (mm)	Width (mm)
011	29	A	Obverse Proximal	Batch 9	33.16	34.36
	30	B	Obverse Distal	Batch 9	26	44.66
	31	C	Obverse Haft	Batch 7	58.03	29.98
012	32	A	Obverse Proximal	Batch 3	32.26	34.96
	33	B	Obverse Distal	Batch 3	33.22	34.91
	34	C	Obverse Haft	Batch 6	45	34.3
013	35	D	Reverse Proximal	Batch 3	26.99	45.82
	36	F	Reverse Haft	Batch 8	55.06	25.88
014	37	D	Reverse Proximal	Batch 3	27.82	63.71
	38	F	Reverse Haft	Batch 6	60.71	23.62
015	39	D	Reverse Proximal	Batch 5	36.04	48.83
016	40	A	Obverse Proximal	Batch 5	35.66	48.16
017	41	D	Reverse Proximal	Batch 3	26.44	46.03
	42	F	Reverse Haft	Batch 10	56.18	24.16
018	43	A	Obverse Proximal	Batch 2	32.68	61.78
019	Not in Collection					
020	44	A	Obverse Proximal	Batch 11	32.92	42.45
	45	C	Obverse Haft	Batch 6	69.19	32.26
021	Not in Collection					
022	46	A	Obverse Proximal	Batch 9	39.66	36.52
	47	B	Obverse Distal	Batch 11	25.79	29.37
	48	C	Obverse Haft	Batch 8	42.18	36.62
023	49	A	Obverse Proximal	Batch 11	19.8	39.62
	50	B	Obverse Distal	Batch 11	22.84	39.66
	51	C	Obverse Haft	Batch 7	44.08	32.64
024	52	A	Obverse Proximal	Batch 1	42.92	45.03

Table A-2. Part 2: Showing individual cast numbers, casting codes, casting locations, batches which the casts were made from, and the individual cast measurements for each Fourche Valley artifact.

Artifact #	Cast #	Location code	Location	Batch #	Length (mm)	Width (mm)
025	53	A	Obverse Proximal	Batch 5	26.05	32.42
	54	C	Obverse Haft	Batch 7	58.72	31.1
026	55	A	Obverse Proximal	Batch 2	28.99	50.29
	56	C	Obverse Haft	Batch 6	57.16	19.48
027	57	A	Obverse Proximal	Batch 1	27.85	35.63
	58	C	Obverse Haft	Batch 8	66.87	27.14
028	59	A	Obverse Proximal	Batch 4	57.5	37.71
029	60	A	Obverse Proximal	Batch 8	39.6	44.51
030	61	D	Reverse Proximal	Batch 2	40.42	36.56
	62	F	Reverse Haft	Batch 4	19.8	42.99
031	63	D	Reverse Proximal	Batch 2	31.29	54.49
032	64	A	Obverse Proximal	Batch 4	30.27	49.2
033	65	A	Obverse Proximal	Batch 9	30.79	35.68
	66	B	Obverse Distal	Batch 11	21.04	35.86
	67	C	Obverse Haft	Batch 12	51.12	31.44
034	68	D	Reverse Proximal	Batch 4	24.98	38.45
035	69	G	Reverse Tip	Batch 6	22.44	23.7
	115	A	Obverse Proximal	Batch 13	23.6	58.36
036	70	D	Reverse Proximal	Batch 13	26.5	51.8
037	71	A	Obverse Proximal	Batch 9	27.4	39.24
038	72	D	Reverse Proximal	Batch 10	30.18	43.62
039	73	A	Obverse Proximal	Batch 11	29.71	42.11
040	74	A	Obverse Proximal	Batch 4	31.3	43.71

Table A-2. Part 3: Showing individual cast numbers, casting codes, casting locations, batches which the casts were made from, and the individual cast measurements for each Fourche Valley artifact.

Artifact #	Cast #	Location code	Location	Batch #	Length (mm)	Width (mm)
041	75	D	Reverse Proximal	Batch 10	22.93	31.14
	76	E	Reverse Distal	Batch 10	23.04	26.11
	77	F	Reverse Haft	Batch 9	47.45	33.85
042	78	A	Obverse Proximal	Batch 3	34.93	37.17
043	79	A	Obverse Proximal	Batch 11	31.89	43.9
044	80	D	Reverse Proximal	Batch 5	29.29	46.58
045	81	A	Obverse Proximal	Batch 4	14.68	42.32
	82	C	Obverse Haft	Batch 9	45.85	16.06
046	83	D	Reverse Proximal	Batch 3	30.25	37.59
047	84	A	Obverse Proximal	Batch 9	17.37	21.62
048	85	C	Obverse haft	Batch 4	18.4	32.12
049	86	A	Obverse Proximal	Batch 10	23.82	49.37
050	87	A	Obverse Proximal	Batch 5	28.64	39.65
051	88	D	Reverse Proximal	Batch 3	23.47	36.2
052	113	A	Obverse Proximal	Batch 13	19.28	26.54
	114	B	Obverse Distal	Batch 13	18.48	26.62
	89	C	Obverse Side	Batch 2	19.29	52.97
053	90	A	Obverse Proximal	Batch 2	15.32	38.12
054	Sherd					
055	91	D	Reverse Proximal	Batch 5	30.08	41.68
	92	F	Reverse Haft	Batch 9	66.79	35.76
056	93	C	Obverse Haft	Batch 1	24.78	44.14

Table A-2. Part 4: Showing individual cast numbers, casting codes, casting locations, batches which the casts were made from, and the individual cast measurements for each Fourche Valley artifact.

Artifact #	Cast #	Location code	Location	Batch #	Length (mm)	Width (mm)
057	94	C	Obverse Haft	Batch 8	50.64	41.25
058	95	D	Reverse Proximal	Batch 4	30.76	44.74
059	96	F	Reverse Haft	Batch 10	47.78	32.96
060	97	D	Reverse Proximal	Batch 3	62.33	32.14
	98	F	Reverse Haft	Batch 3	69.12	25.12
061	99	A	Obverse Proximal	Batch 4	38.7	32.82
	100	B	Obverse Distal	Batch 4	40.07	32.55
	101	F	Reverse Haft	Batch 4	41.02	35.41
062	102	C	Obverse Haft	Batch 12	84.65	33.4
063	103	D	Reverse Proximal	Batch 2	33.98	56.24
064	104	A	Obverse Proximal	Batch 3	32.95	43.41
065	105	A	Obverse Proximal	Batch 12	22.18	44.31
	106	C	Obverse Haft	Batch 10	62.88	29.76
066	107	D	Reverse Proximal	Batch 5	35.08	50.52
067	108	A	Obverse Proximal	Batch 4	27.57	38.29
	109	B	Obverse Distal	Batch 5	29.89	33.22
	110	C	Obverse Haft	Batch 5	34.5	36.8
068	111	D	Reverse Proximal	Batch 2	26.94	43.7
	112	F	Reverse Haft	Batch 7	50.93	32.93

Table A-2. Part 5: Showing individual cast numbers, casting codes, casting locations, batches which the casts were made from, and the individual cast measurements for each Fourche Valley artifact.

Batch Number	A	B	Color	Date	Time
1	13.8 g	3.4 g	0.1 g	1/24/2013	9:00 AM
2	49.2 g	12.3 g	0.2 g	2/2/2013	2:00 PM
3	50.0 g	12.7 g	0.2 g	2/2/2013	3:00 PM
4	50.4 g	12.9 g	0.2 g	2/13/2013	11:30 AM
5	50.0 g	12.5 g	0.2 g	2/13/2013	12:00 PM
6	51.0 g	12.7 g	0.2 g	3/6/2013	12:25 PM
7	72.8 g	18.2 g	0.5 g	3/6/2013	12:40 PM
8	101.0 g	25.2 g	0.7 g	3/6/2013	1:00 AM
9	73.4 g	18.3 g	0.3 g	3/13/2013	1:00 PM
10	60.0 g	15.0 g	0.3 g	3/13/2013	1:45 PM
11	58.0 g	14.5 g	0.2 g	3/13/2013	2:00 PM
12	50.5 g	12.6 g	0.2 g	3/13/2013	2:30pm
13	40.1 g	10.1 g	0.1 g	4/10/2013	12:30 PM

Table A-3. Casting batches showing amount of material used.

Time Period	Phase		Period	Culture
A.D 1700			Mississippian	Caddoan
A.D 1100				
A.D. 1000	Evans phase		Woodland	Fourche Maline IV
A.D. 900				
A.D. 800	Akers phase			Fourche Maline III
A.D. 700				
A.D. 600				
A.D. 500	Scott phase			Fourche Maline II
A.D. 400				
A.D. 300				
A.D. 1	Williams phase			Fourche Maline I
300 B.C.				
1500 B.C			Late Archaic	

Table 1. Fourche Maline phases adapted from Leith 2011.

	Artifact	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Count
Practice Pieces or Toys						8
Largest	Artifact 020	444.2	101.2	97.7	34.7	
Smallest	Artifact 030	97.1	89.5	66.5	17.1	
Double Bitted - Triangular						5
Largest	Artifact 001	189.9	118.4	64.9	25.8	
Smallest	Artifact 003	116.6	105.7	61.3	18.9	
Double Bitted - Rounded						10
Largest	Artifact 011	188.9	100.4	69.2	24.3	
Smallest	Artifact 002	99.2	90.5	55.0	18.0	
Damaged Double Bitted						20
Largest	Artifact 016	270.6	83.8	71.0	32.8	
Smallest	Artifact 047	23.6	45.1	29.5	14.7	
Single Bitted						6
Largest	Artifact 035	154.2	89.3	63.3	38.6	
Smallest	Artifact 039	34.3	50.9	45.0	13.8	
Elongated						5
Largest	Artifact 008	167.6	100.0	47.6	33.9	
Smallest	Artifact 052	29.4	58.0	31.0	15.3	
Damaged						10
Largest	Artifact 064	102.4	48.4	66.7	20.6	
Smallest	Artifact 050	28.2	29.6	54.4	16.7	

Table 2. Largest and smallest tools in the Fourche Valley site categories.

Material	Preforms	Double Bitted	Double Bitted	Double Bitted - Damaged	Single Bitted	Bifacial	Bifacial	Damaged - style not determined
		Triangular Edged	Rounded Edged	All Rounded Edged	All Rounded Edged	Triangular Edged	Rounded Edged	
Silified	018	001	002	015	034	033	008	031
Sandstone	068	003	004	016	035	041	052	032
		009	005	024	039		053	036
		012	006	025	042			038
		061	007	026	046			043
			010	027				044
			011	028				049
			023	029				050
			067	037				051
				045				064
				047				
				048				
				057				
				058				
				059				
				066				
Sandstone	013		065	014				
	017			056				
	020			060				
	030							
	055							
	062							
Chert			022					
Slate				063	040			

Table 3. Fourche Valley Archaeological Collection - Form and Material Categories

Code Letter	Location on Tool
A	Obverse Proximal
B	Obverse Distal
C	Obverse Haft
D	Reverse Proximal
E	Reverse Distal
F	Reverse Haft
G	Reverse Tip
H	Obverse Tip

Table 4. Casting codes and locations

Scott County Experimental	Weight (g)	Length (mm)	Width (mm)	Thickness	Hafting Width (mm)	Tip width (mm)	Style	Material
1	694.9	1780	101.68	28.7	56.35	n/a	Double	SSS
2	90	100.7	42.92	21.5	n/a	22.94	Bifacial	SSS
3	173.7	110.83	81.42	23.5	n/a	31.53	Single	SSS
4	29.4	56.2	49.92	13.5	n/a	11.63	Single	SSS
5	40.7	63.56	50.91	16	n/a	13.94	Single	SSS
6	145.3	98.76	68.75	18.2	48.53	n/a	Double	chert
7	258.8	122.15	74.32	22.7	55.97	n/a	Double	SSS
8	154.9	88.59	57.72	21.4	41.59	n/a	Double	SSS
9	44.4	58.63	52.4	17.8	n/a	18.88	Single	SSS
10	303.9	112.72	81.26	30.1	54.53	n/a	Double	SSS
11	106.5	100.66	64.67	23.1	n/a	28.02	Single	SSS
12	136	129.95	53.67	28.2	n/a	15.42	Single	SSS
13	81.1	80.15	47.52	21	32.4	n/a	Double	SSS
14	73.4	69.32	42.15	21.4	n/a	n/a	Bifacial	SSS
15	74.8	80.53	49.92	19.3	n/a	n/a	Bifacial	SSS
16	85.5	70.02	49.66	19.9	40.72	n/a	Double	SSS
17	70.3	97.26	47.89	12.9	34.28	n/a	Double	SSS
18	46.9	71.27	45.29	14.1	38	n/a	Double	SSS
19	174.2	94.67	60.69	24.8	50.07	n/a	Double	SSS
20	110.2	82.8	64.09	28.9	n/a	21.34	Single	SSS

Table 5. Scott County Experimental Replica Collection

Material	Double Bitted	Single Bitted	Bifacial
Silicified Sandstone	SC 01	SC 03	SC 02
	SC 07	SC 04	SC 14
	SC 08	SC 05	SC 15
	SC 10	SC 09	
	SC 13	SC 11	
	SC 18	SC 12	
		SC 20	
Sandstone	SC 16		
	SC 19		
Chert	SC 06		
	SC 17		

Table 6. Scott County Experimental Replica Collection – Form and Material Categories

	Double Bitted	Single Bitted	Bifacial
Wood working	SC 08	SC 03	SC 14
	SC 13	SC 04	
	SC 17	SC 09	
	SC 19	SC 11	
		SC 12	
		SC 20	
Argicultural use	SC 01		SC 02
	SC 06		
	SC 07		
	SC 10		
Marrow extraction	SC 18		
Damaged in Production	SC 16	SC 05	SC 15

Table 7. Uses of the Scott County Experimental Collection by tool form

Appendix 2: Fourche Valley Artifact and Use-Wear Catalog

The follow is the list of the entire Fourche Valley site double bitted tool collection, consists of 65 tools. This catalog discusses each tool individually, focusing on any unique characteristics, damage or obvious wear and states the major measurements. Casts of the tools are also discussed with locations where they were taken, the measurements for each cast and the batches from which each cast was created (See Tables 6 and 7 in Appendix 1 for casting and batch information). The cast measurements consist of length, the distance from the tool edge towards the center, and the width of the total area the cast cover. Each artifact has images of both reverse and obverse sides as well as edges of each tool and images of casting locations. This section also documents all of use-wear for each artifact. The analysis of these wear is discussed in Chapter 4.

Artifact 001

Artifact 001 is a complete double bitted tool with triangular edges, and is almost symmetrical with a slight twist in the center (Figure 104). The artifact is made of course dark silicified sandstone. Both proximal and distal ends are present and the hafting portion is intact. The artifact has coarse flacking with numerous large flakes removed and step fractures can be seen. This tool appears to have been heavily reworked and the hafting portion shows considerable smoothing. Both proximal and distal edges show smoothing and grinding wear. Artifact 001 weighs 189.9 grams, with a length of 188.4 mm, a width 64.9 mm, a hafting width of 46.6 mm and a max thickness of 25.8 mm.

Casting

A total of three casts were taken from Artifact 001, the obverse proximal side (A), the obverse distal side (B), and the obverse haft (C). The obverse proximal cast, Cast #1 was taken

from Batch #9 and is 34.02 mm in length and 36.52 mm in width. Cast #2, the obverse distal edge, was created out of Batch 10 and is 31.77 mm in length and 32.14 mm in width. The obverse haft, Cast #3, was made from Batch 12 and is 51.52 mm in length and 34.07 mm in width (Figure 105).

Use-wear

Use-wear on this tool shows evidence of both additive and abrasive wear (Figures 106-115). Microplating can easily be seen and well as cast error in the form of oils. Cleaning scrape for sharpening of the tool can be seen and striations running obliquely parallel to the bit edge. Hafting wear shows microplating and few striations from particles in the hafting.



Figure 104. The obverse and reverse sides of Artifact 001.

**3 YE 0948
001
Obverse Side**

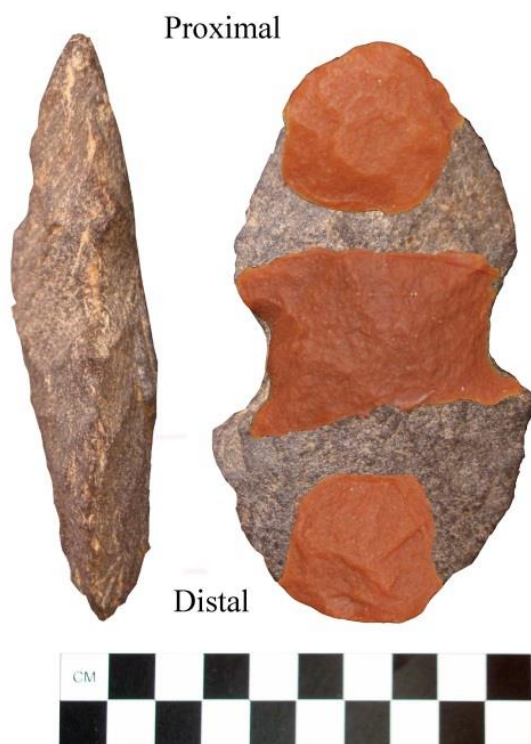


Figure 105. Casting locations on the obverse side of Artifact 001.

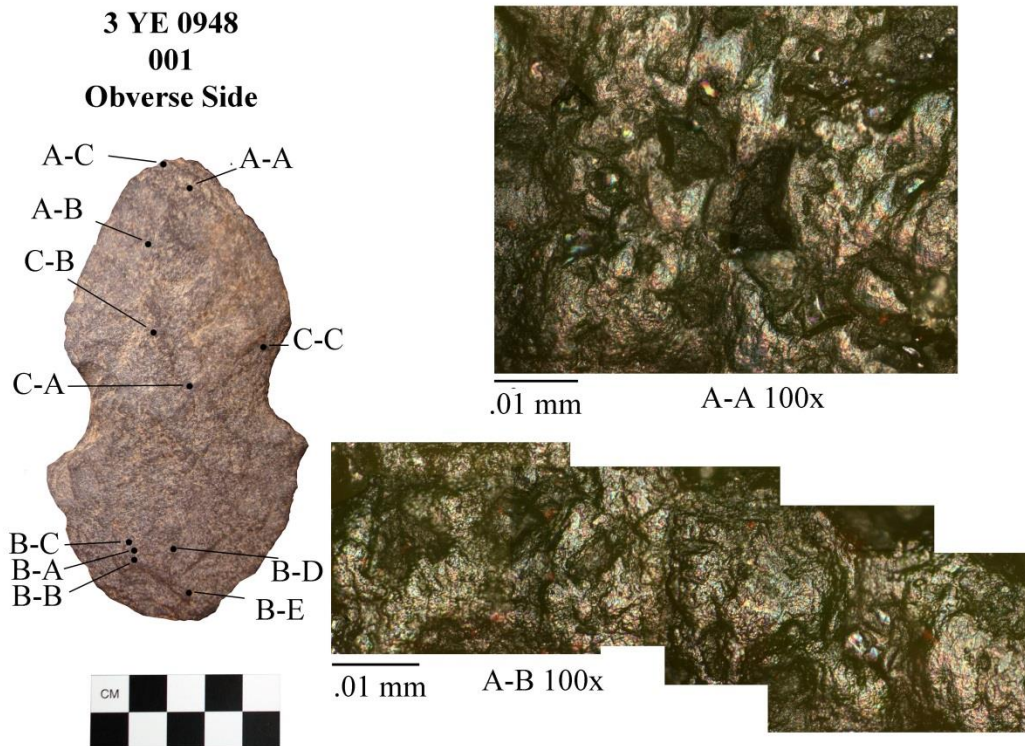


Figure 106. Bit wear on the obverse side of Artifact 001, Locations A-A and A-B, showing additive microplating with light abrasive wear.

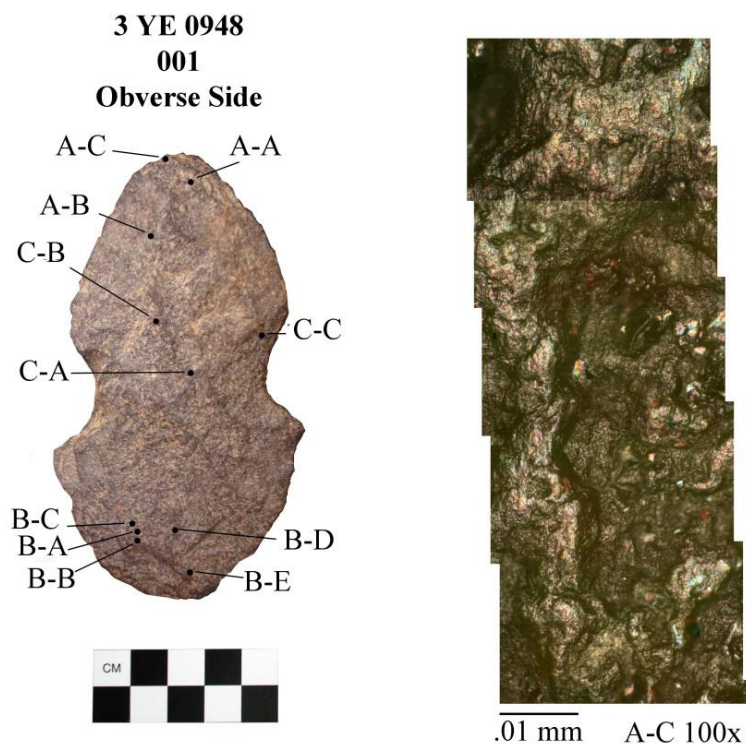


Figure 107. Bit wear on the obverse side of Artifact 001, Location A-C, showing additive microplating wear and generalized abrasion.

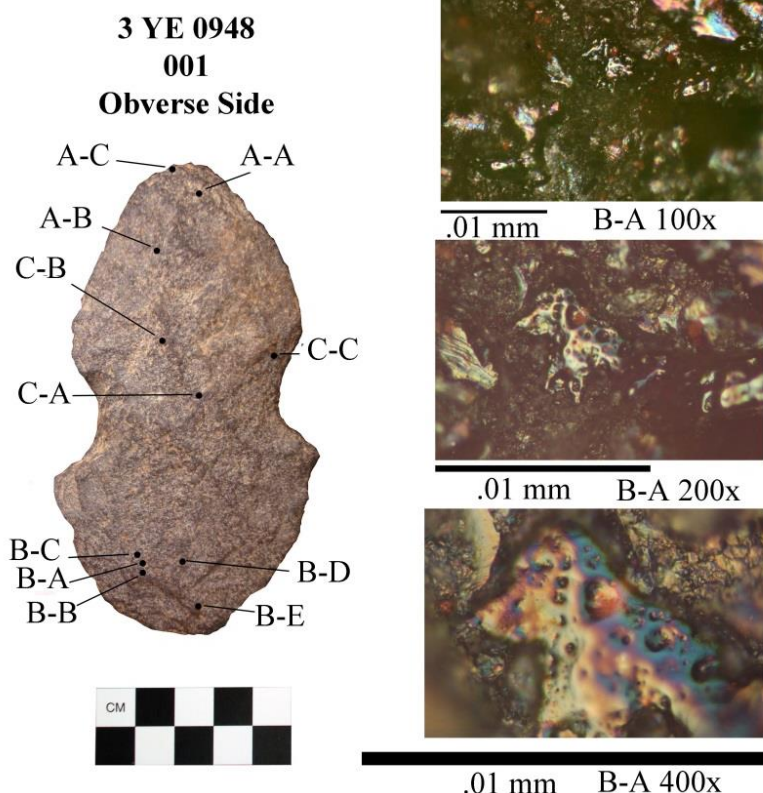


Figure 108. Casting error on the obverse side of Artifact 001, Location B-A, showing oil/grease error.

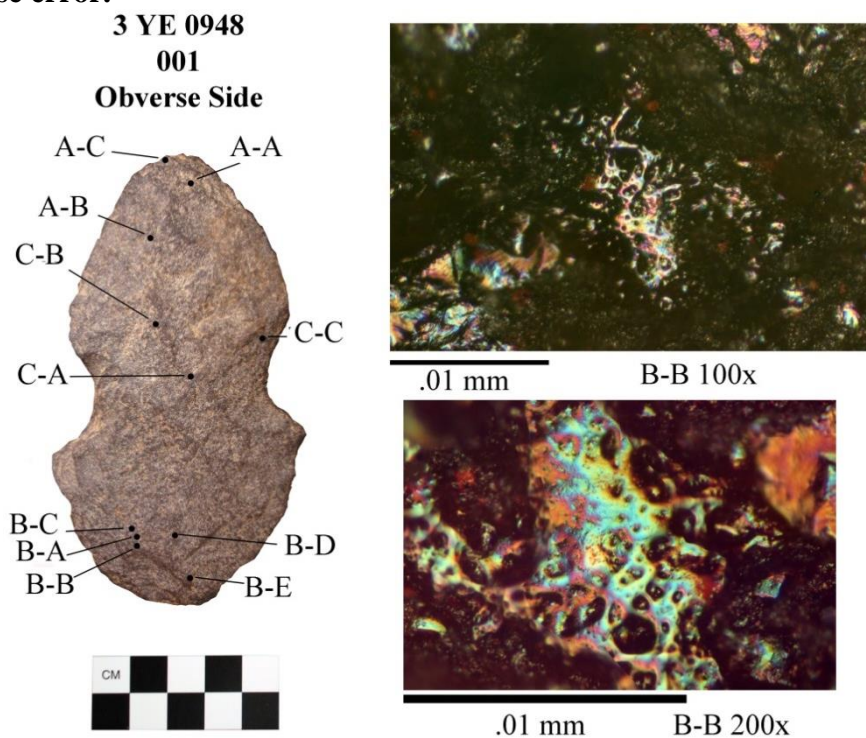


Figure 109. Casting error on the obverse side of Artifact 001, Location B-B, showing oil/grease error.

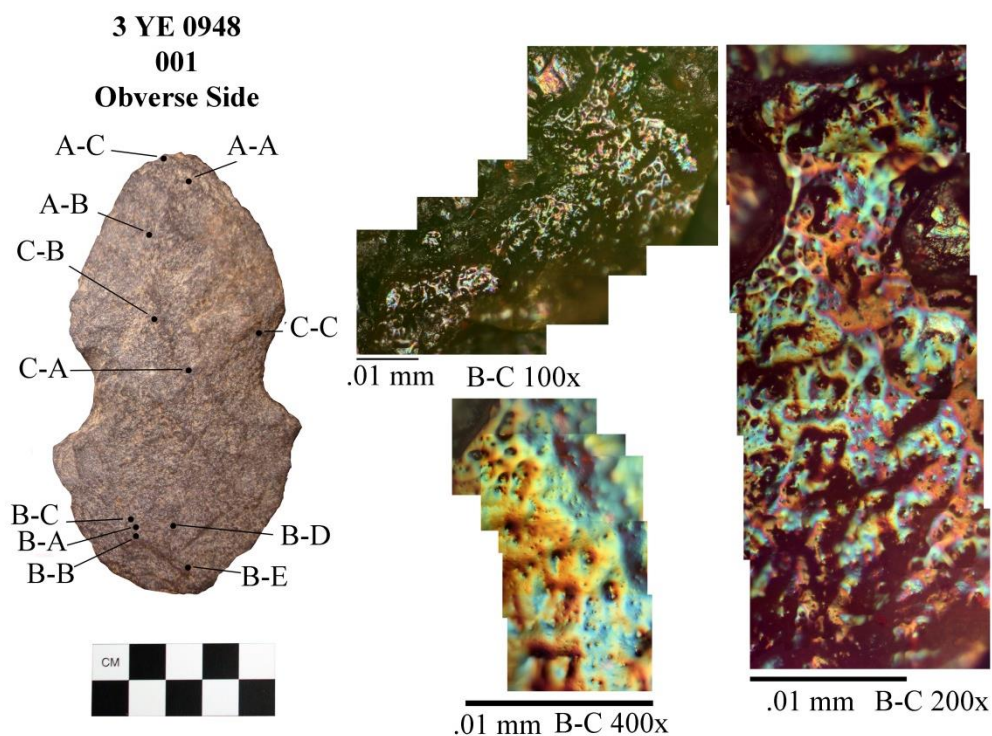


Figure 110. Casting error on obverse side of Artifact 001, Location B-C, showing oil/grease error.

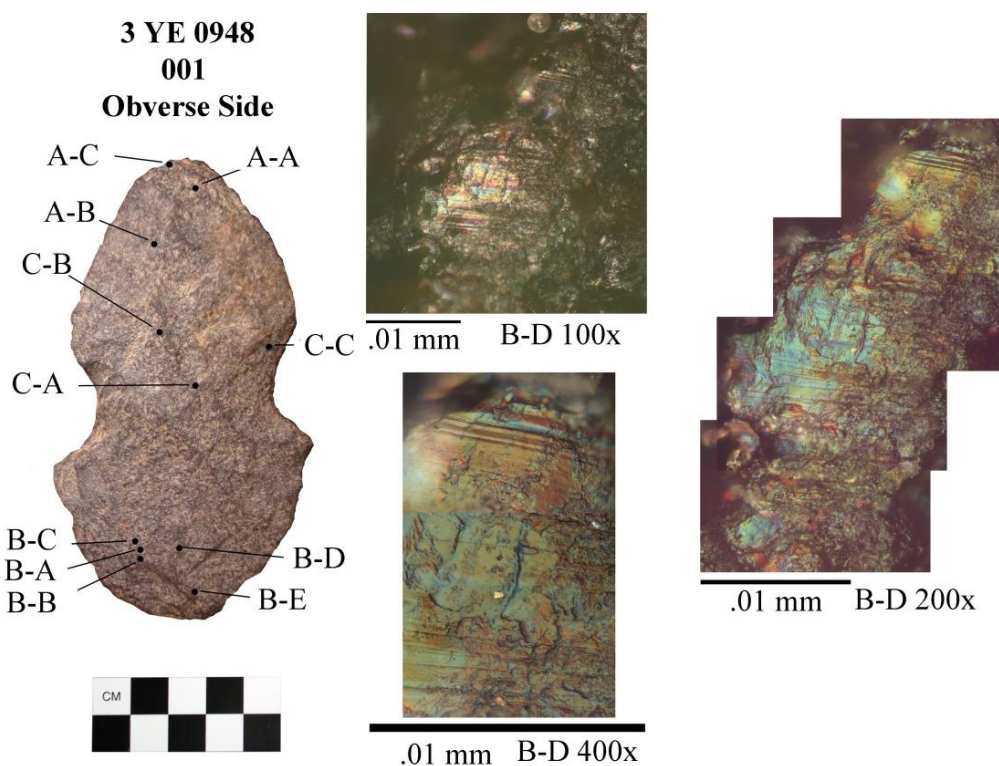


Figure 111. Bit wear on obverse side of Artifact 001, Location B-D, showing a cleaning scrape created during the sharpening of the tool edge. A large additive plane can be seen which has abrasive wear with striations running parallel to tool edge.

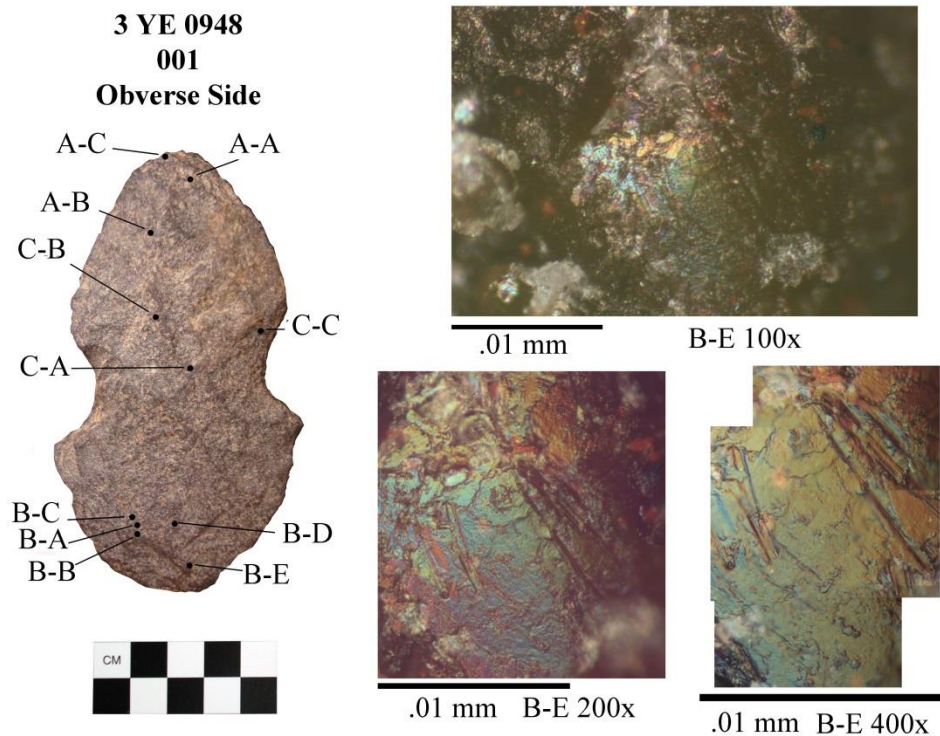


Figure 112. Bit edge wear on obverse side of Artifact 001, Location B-E, showing additive wear with striations obliquely perpendicular to tool edge.

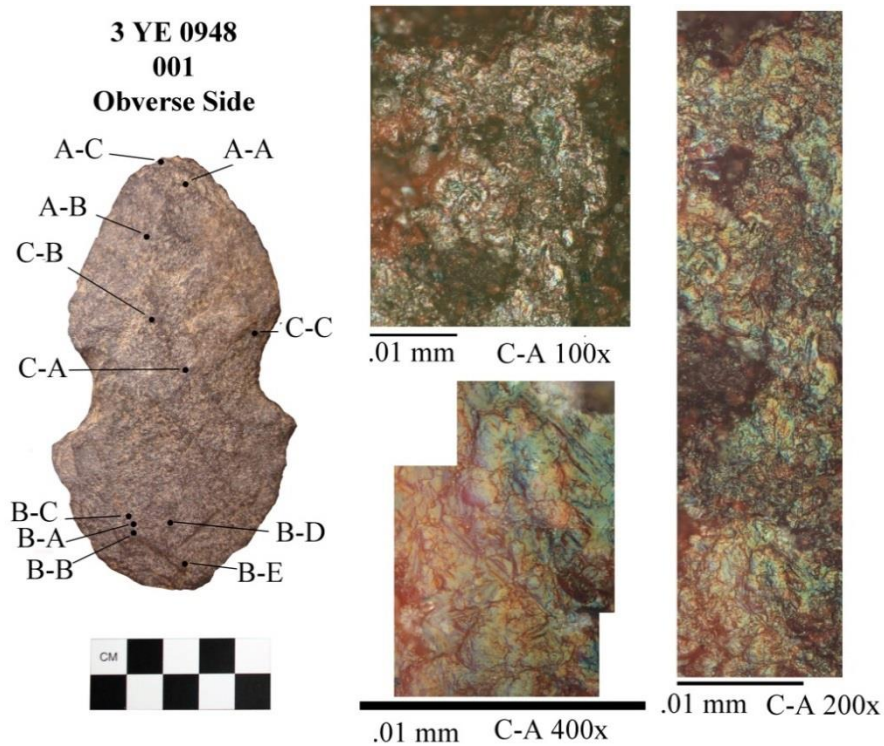


Figure 113. Hafting wear on obverse side of Artifact 001, Location C-A, showing microplating wear with partially filled in obliquely angled striation wear.

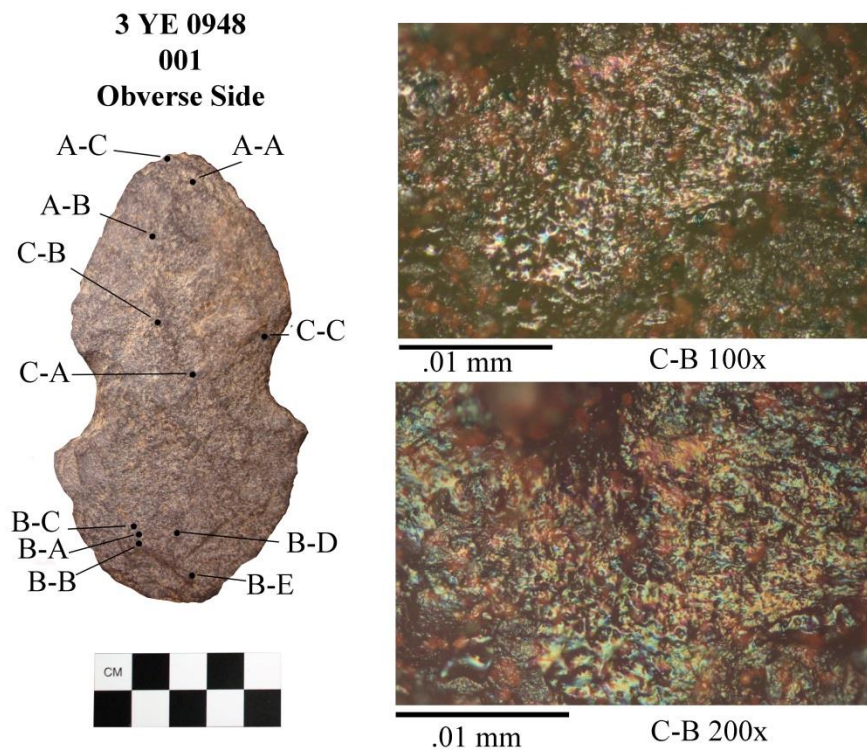


Figure 114. Casting error on the obverse side of Artifact 001, Location C-B, showing oil/grease error.

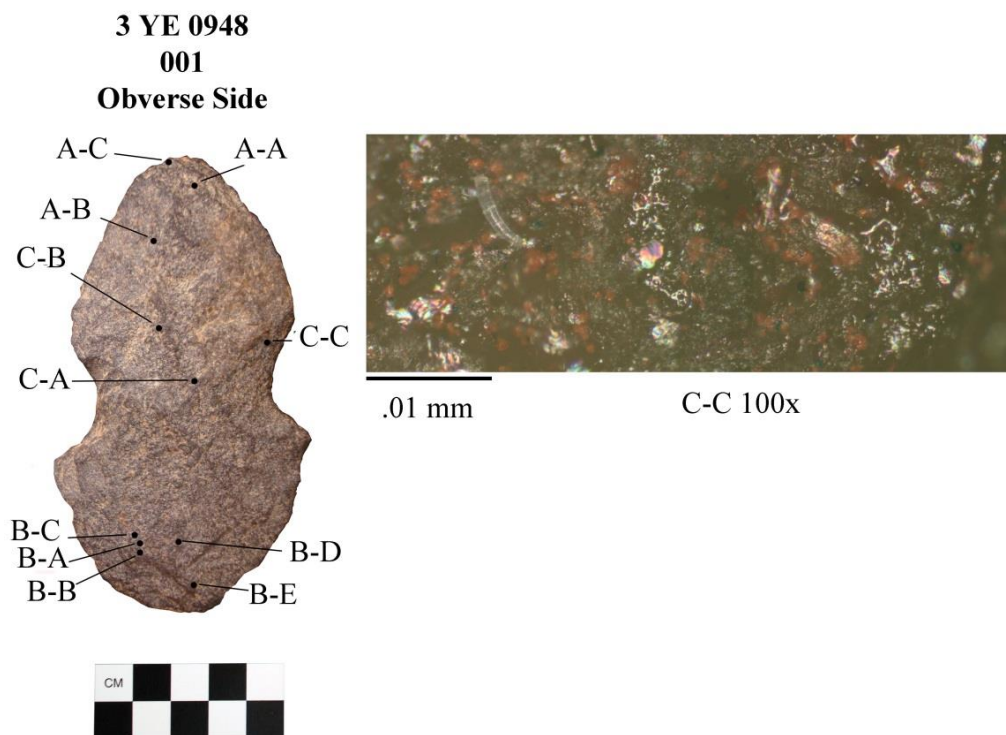


Figure 115. Casting error on the obverse side of Artifact 001, Location C-C, showing oil/grease error.

Artifact 002

Artifact 002 is a complete double bitted tool with rounded edges made from silicified sandstone (Figure 116). Proximal and distal ends are present and both show heavy wear. Step fracture on the distal edge on the obverse side is possibly the result of failure during re-sharpening. Both blades edges are fairly sharp with visible smoothing and deliberate grinding. There is evidence of polish on both the hafting and a section on the central distal end on the obverse side. Both notches in the hafting show evidence of smoothing. Artifact 002 is one of the smaller complete tools, weighing 99.2 grams, with a length of 90.5 mm, a width of 55.0 mm, a hafting width of 44.2 mm and the max thickness measuring in at 14.1 mm.

Casting

Three casts were taken from Artifact 002, the obverse proximal (A), the obverse distal (B) and the reverse haft (C). Cast #4, the obverse proximal, was taken from Batch 13 and measures 25.4 mm in length and 39.2 mm in width. The obverse distal, Cast #5 was taken from Batch 9 and measures 33.1 mm in length and 32.14 mm in width. Cast #6, the reverse haft, was created out of Batch 8 and measures 43.36 mm in length and 23.01 mm in width (Figure 117).

Use-wear

Wear on Artifact 002 consists of both additive and abrasive wear (Figures 118-127). Microplating can be seen on the tool as well as some locations with heavy striations. Cleaning scrapes can be seen as well as locations of pseudo-wear. Hafting wear shows heavy abrasion with no obvious striations, but abrasive and additive wear can be seen.



Figure 116. The obverse and reverse sides of Artifact 002.

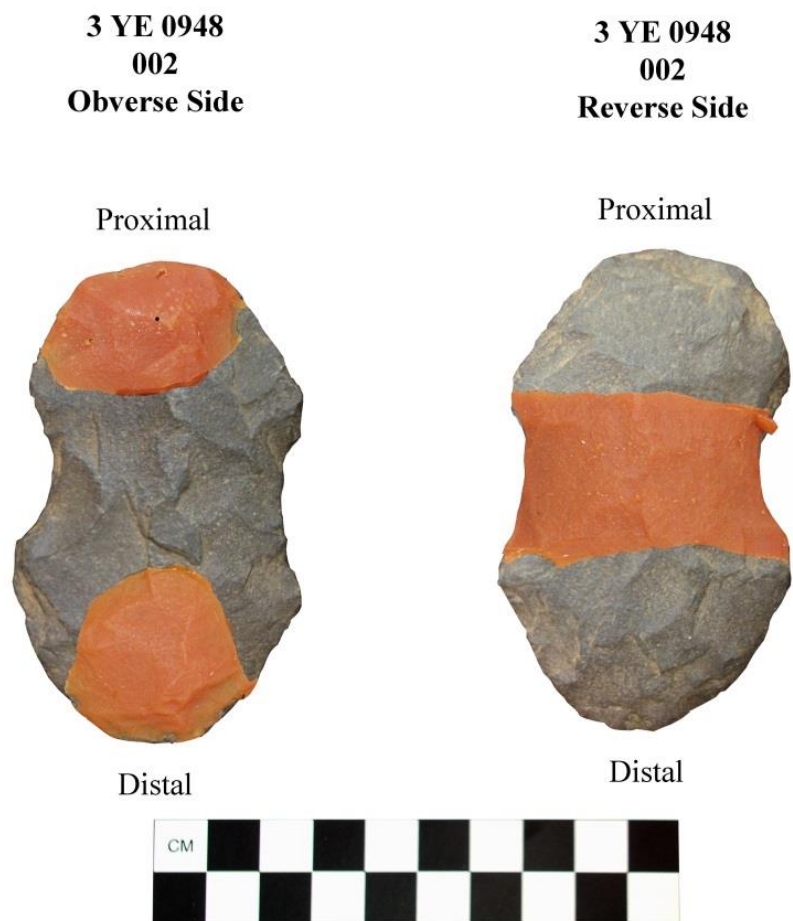


Figure 117. Casting location on the obverse and reverse sides of Artifact 002.

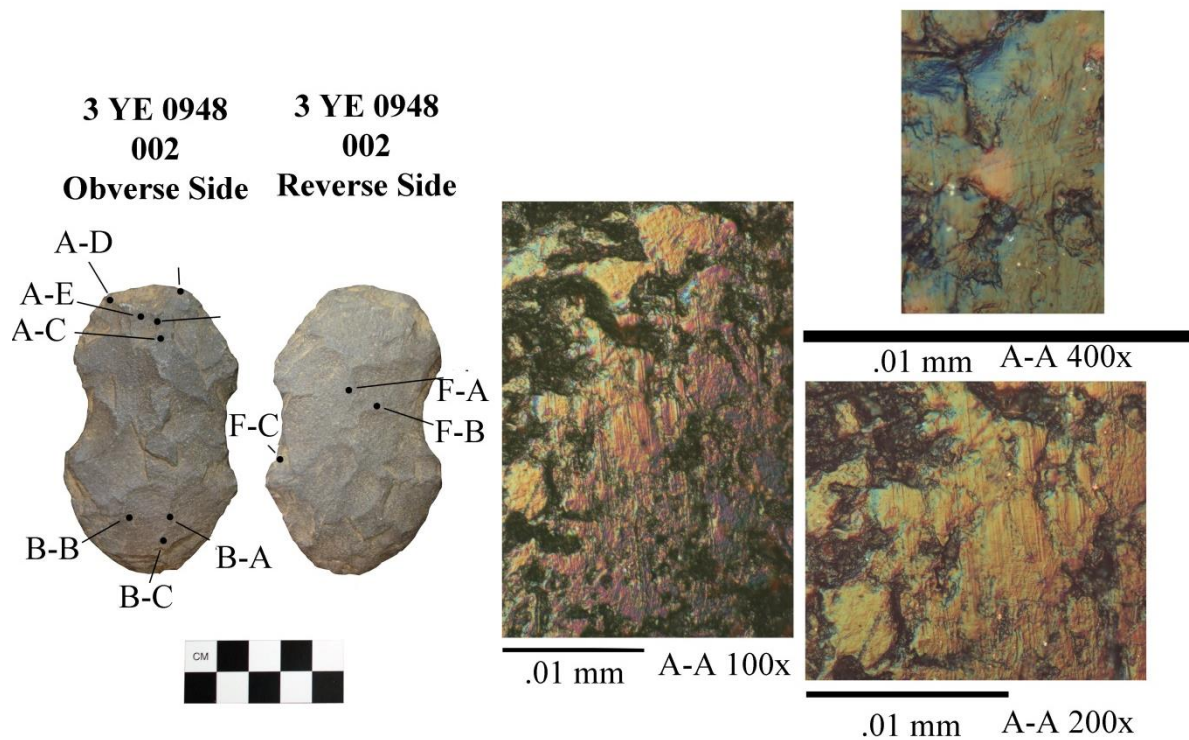


Figure 118. Bit edge wear on the obverse side of Artifact 002, Location A-A, showing abrasive wear with striations running perpendicular to the bit edge.

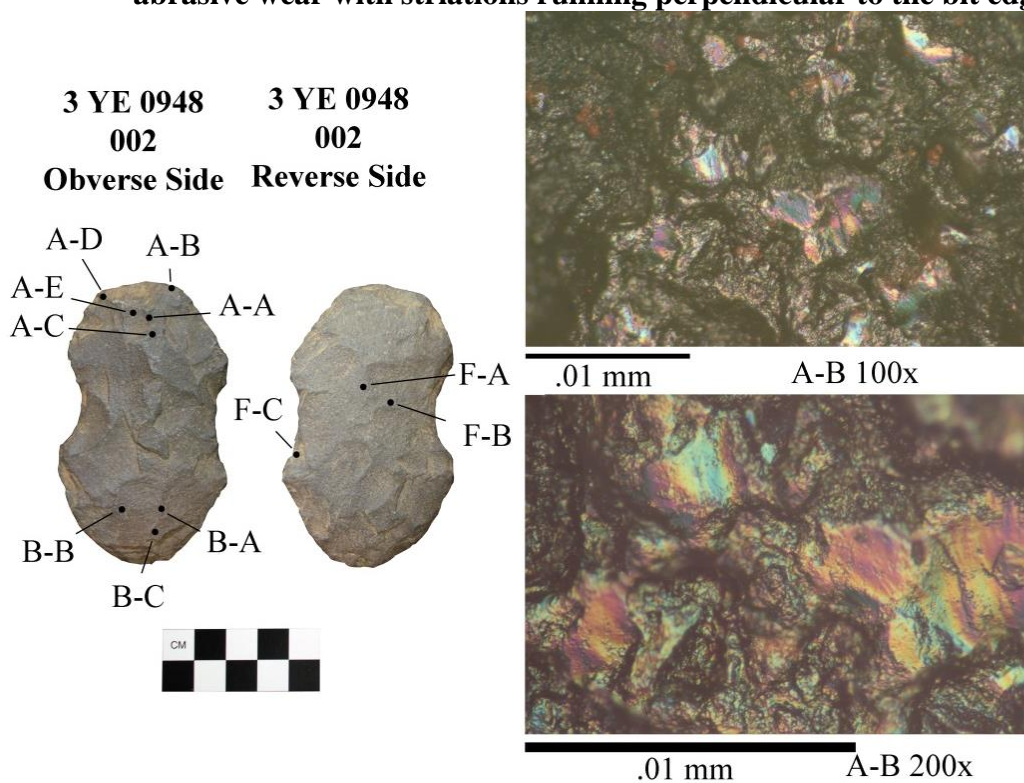
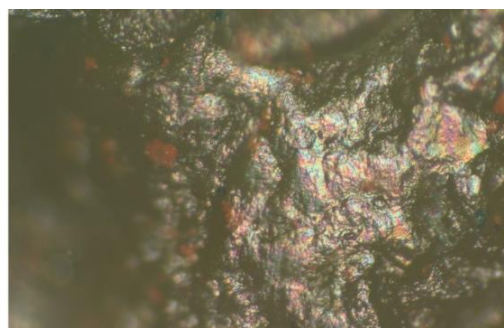
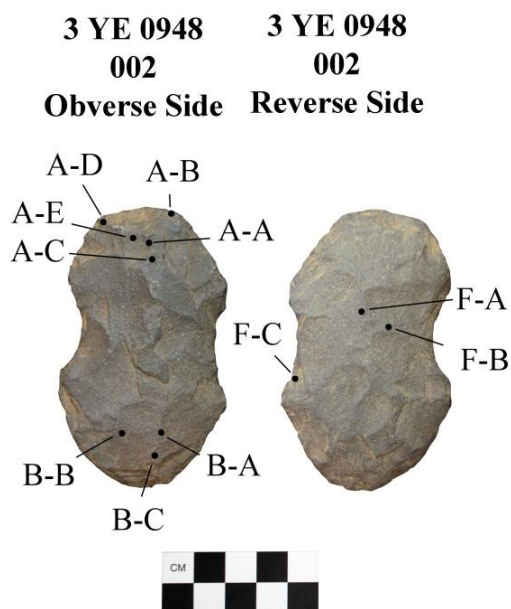
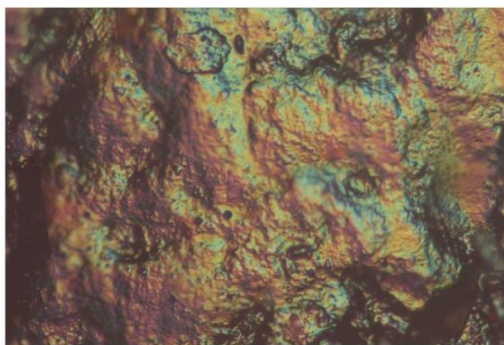


Figure 119. Bit edge wear on the obverse side of Artifact 002, Location A-B, showing abrasive wear and pseudo-wear in the form of conchoidal fractures.

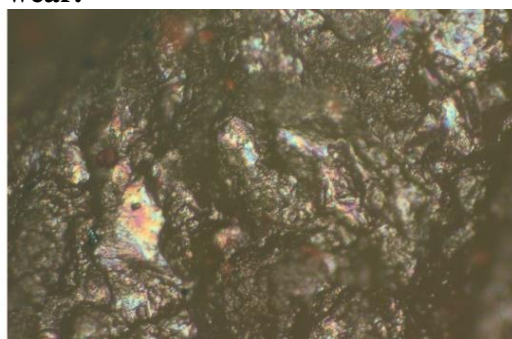
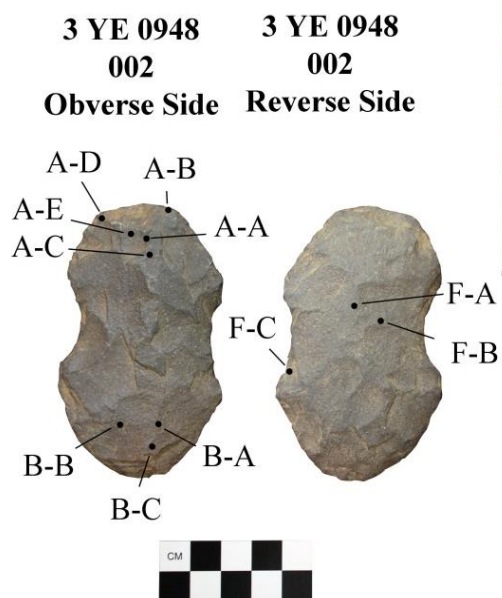


A-C 100x

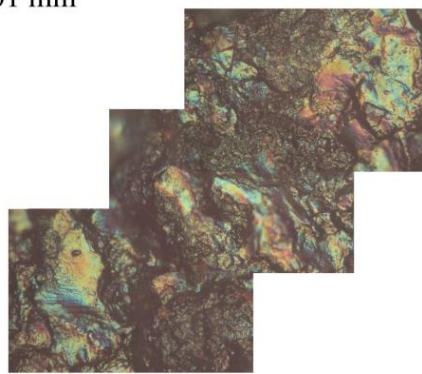


A-C 200x

Figure 120. Bit edge wear on the obverse side of Artifact 002, Location A-C, showing additive microplating worn by abrasive wear.



A-D 100x



A-D 200x

Figure 121. Bit edge wear on obverse side of Artifact 002, Location A-D, showing light abrasive wear and pseudo-wear in the form of conchoidal fractures.

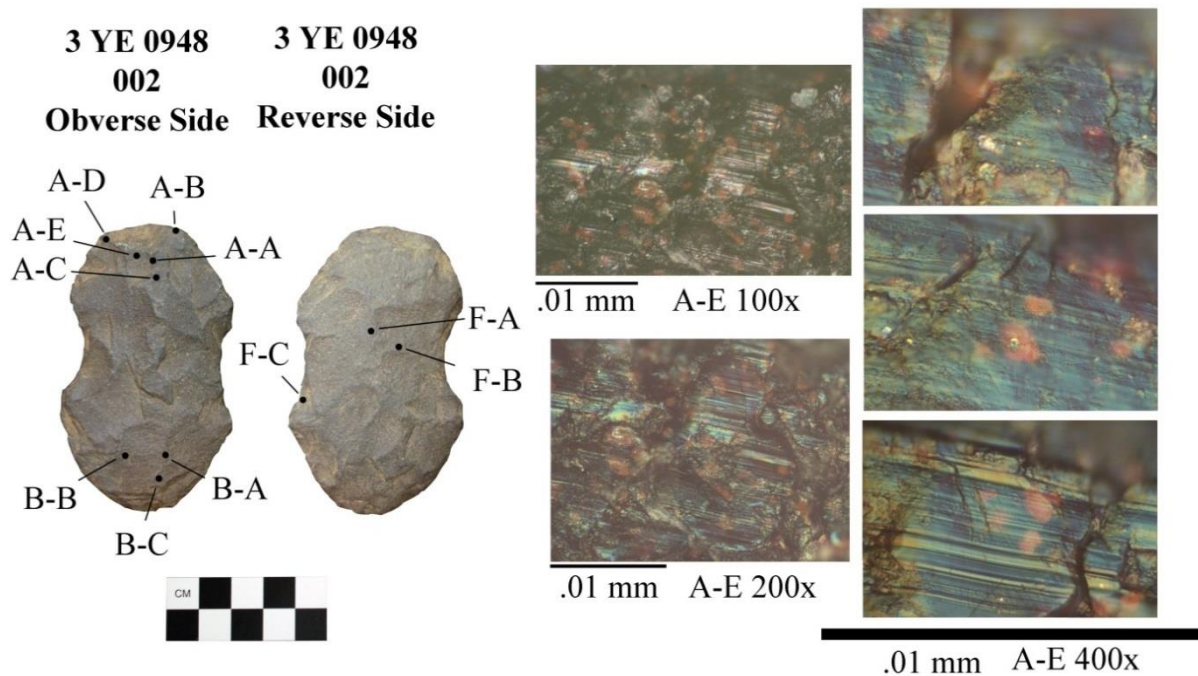


Figure 122. Bit edge wear on obverse side of Artifact 002, Location A-E, showing a cleaning scrape with striations running parallel to the bit edge and pseudo-wear in the form of conchoidal fractures.

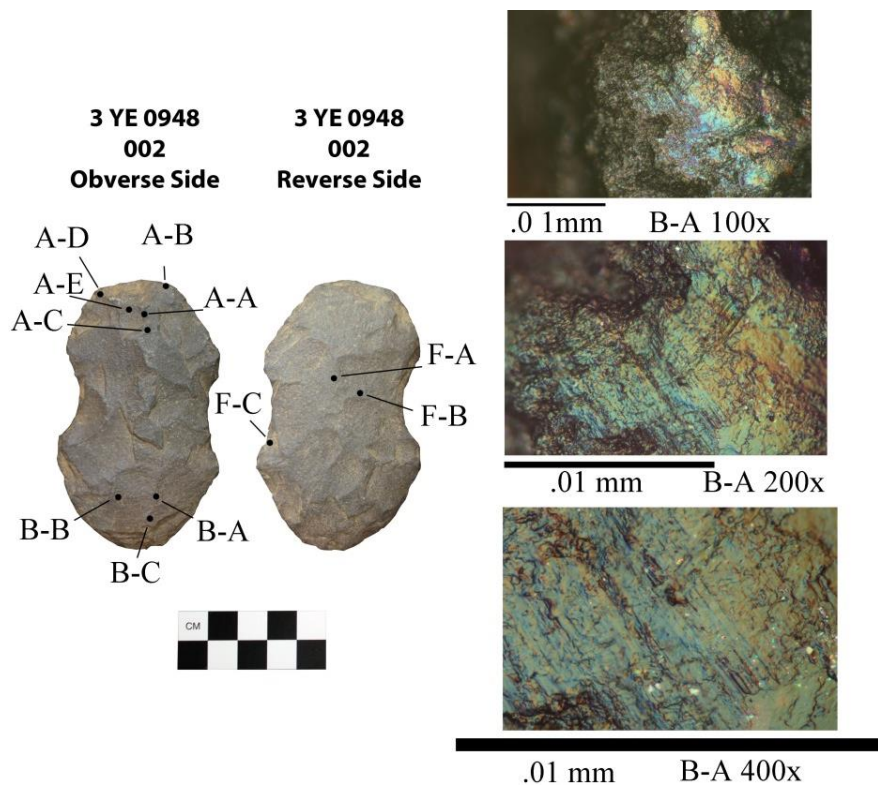
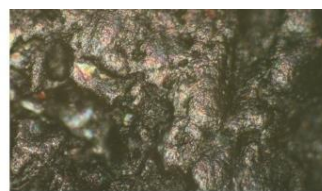
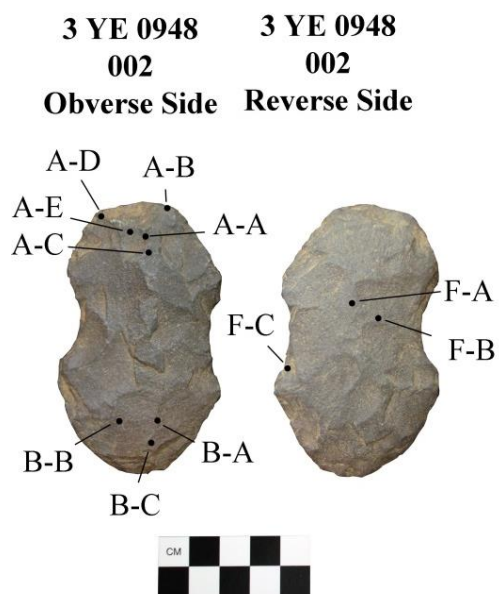


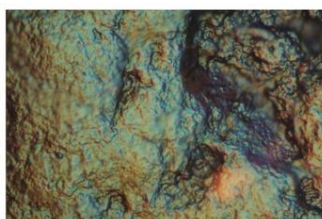
Figure 123. Bit edge wear on the obverse side of Artifact 002, Location B-A, showing abrasive and additive wear, with microplating and striations running obliquely to the bit edge.



.01 mm B-B 100x

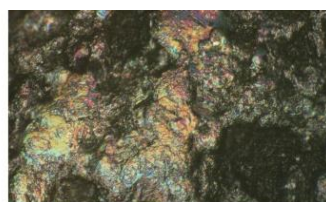
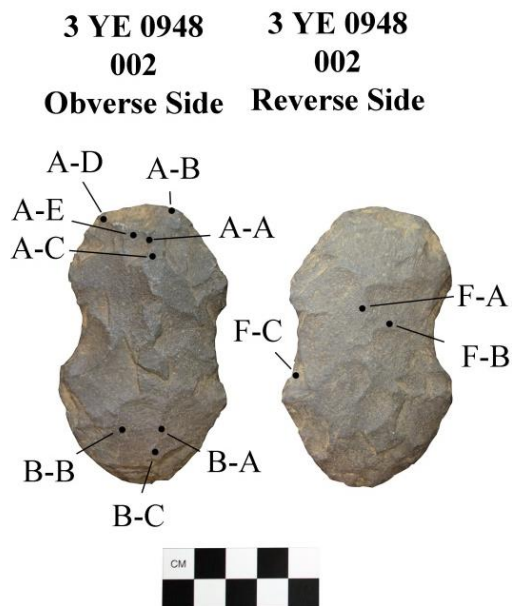


.01 mm B-B 200x



.01 mm B-B 400x

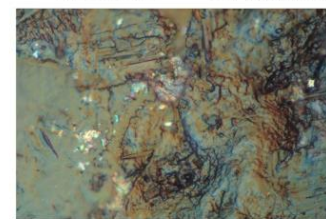
Figure 124. Bit edge wear on obverse side of Artifact 002, Location B-B, showing abrasive wear on previous microplating.



.01 mm B-C 100x



.01 mm B-C 200x



.01 mm B-C 400x

Figure 125. Bit edge wear on the obverse side of Artifact 002, Location B-C, showing additive wear with microplating and light striations running parallel to the bit edge.

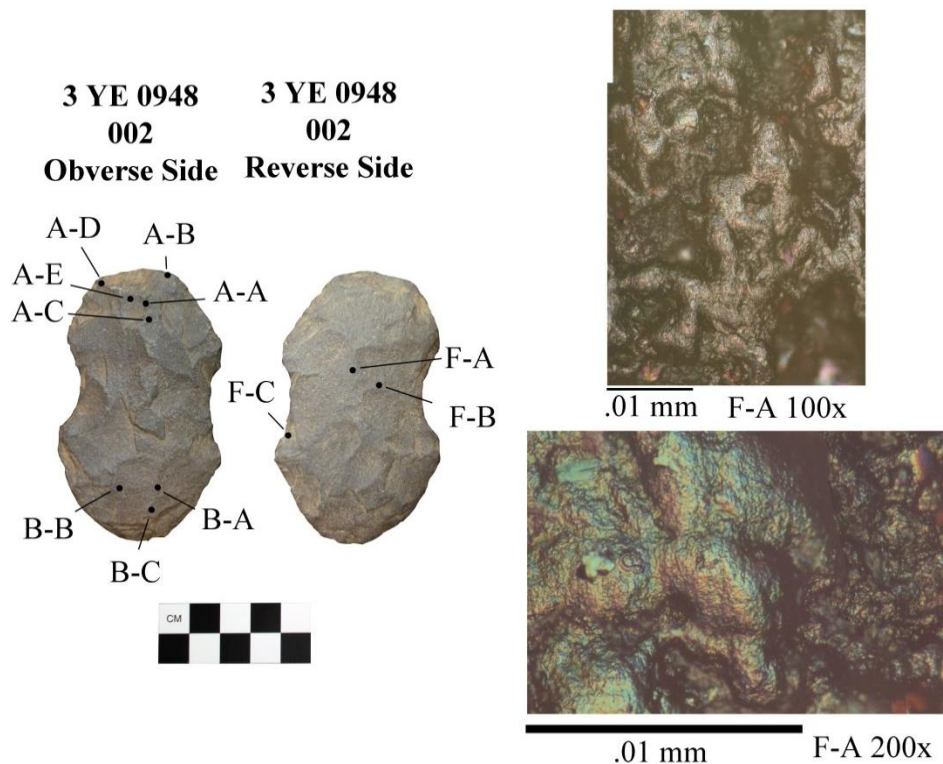


Figure 126. Hafting wear on the reverse side of Artifact 002, Location F-A, showing additive microplating and light abrasive wear.

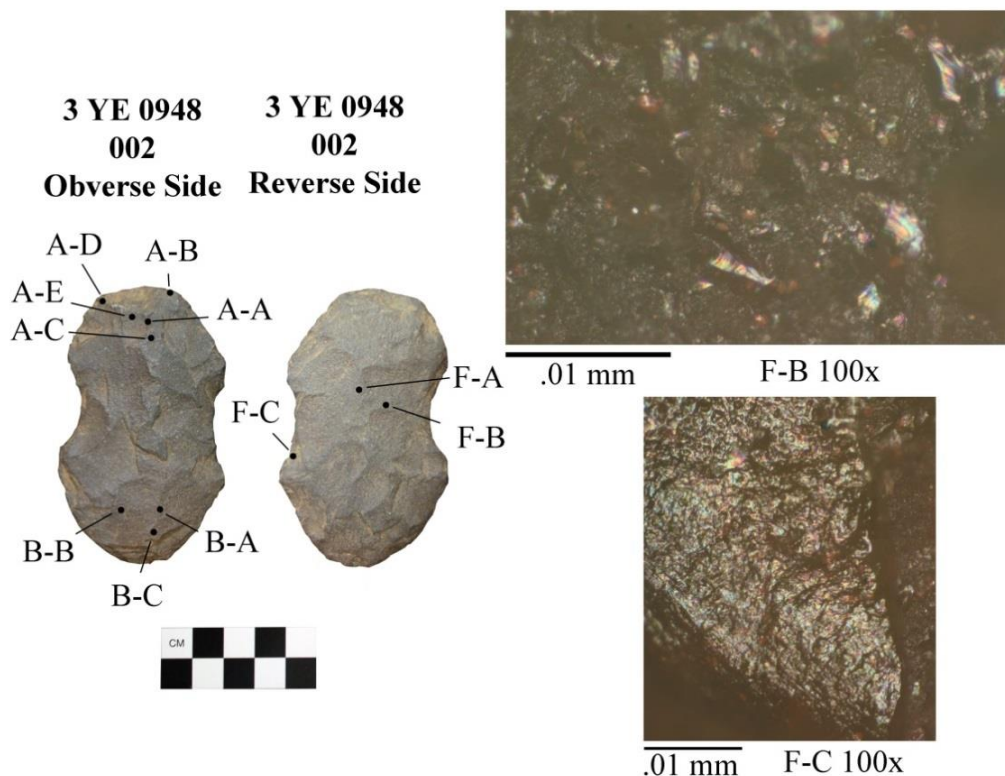


Figure 127. Hafting wear on the reverse side of Artifact 002, Locations F-B and F-C, showing pseudo-wear in the form of conchoidal fractures (F-B) and abrasive wear (F-C).

Artifact 003

Artifact 003 is a complete double bitted tool with triangular edges (Figure 128) with proximal, distal and hafting portions intact. The tool lacks symmetry and has a distinctive twisting in the hafting. Artifact 003 has a large step fracture on the reverse side that would have made continuing maintenance on the tool difficult. Edges are sharp, and tool has no obvious macro evidence of use wear such as grinding or polish. Artifact 003 weighs 116.6 grams with a length of 105.7 mm, width of 61.3 mm, hafting width of 43.0 mm and a maximum thickness of 18.9 mm and is made of silicified sandstone.

Casting

All three molds, proximal (A), distal (B) and haft (C) were taken from the obverse side. Cast #7, the obverse proximal was taken from Batch 11 and is 31.04 mm in length and 36.88 mm in width. The obverse distal, Cast #8, was created from Batch 9 and measures 29.74 mm in length and 33.68 mm in width. Cast #9, the obverse haft was made from Batch 7 and measures 42.78 mm in length and 37.45 mm in width (Figure 129).

Use-wear

Wear on Artifact 003 consists of both additive and abrasive wear (Figures 130-134). Large plane of microplating and striations running perpendicular to the bit edge can be seen. Hafting wear consists of light generalized abrasion with the beginnings of additive wear.

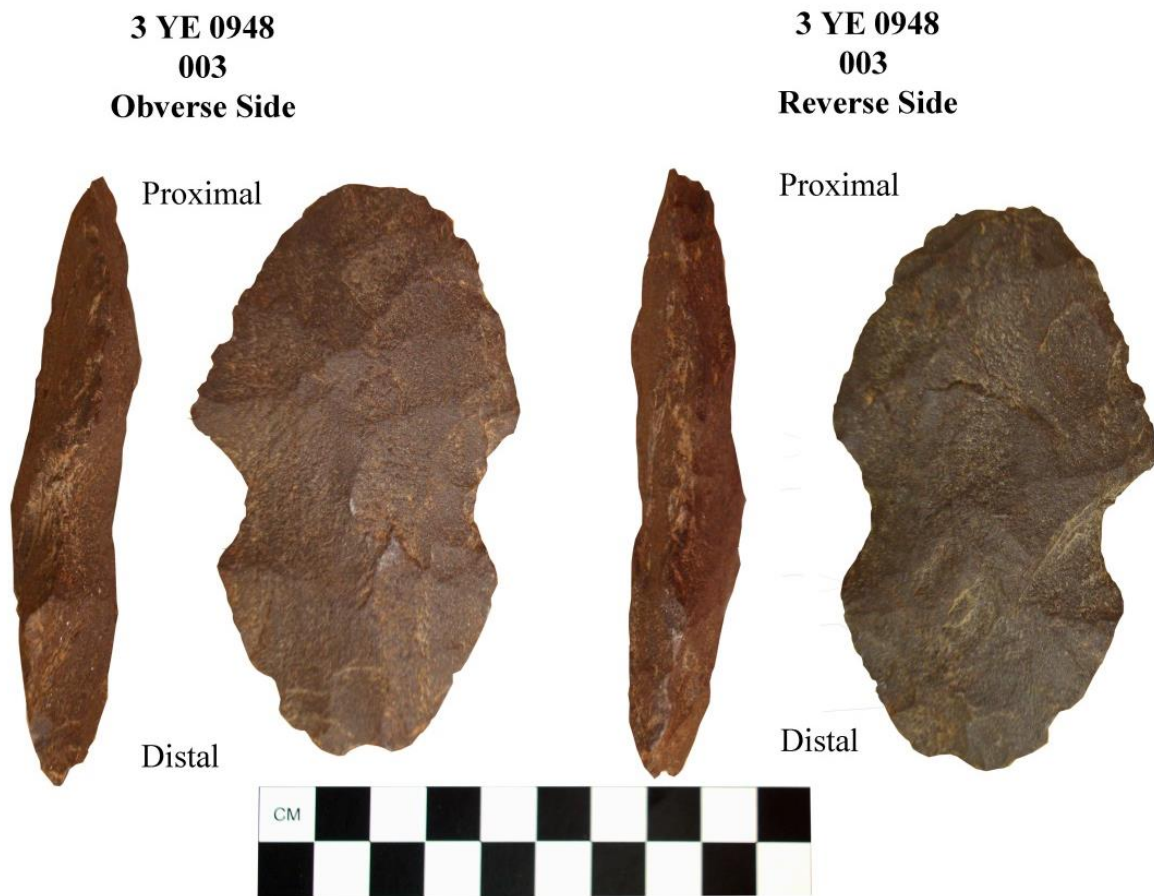


Figure 128. The obverse and reverse sides of Artifact 003.

**3 YE 0948
003
Obverse Side**

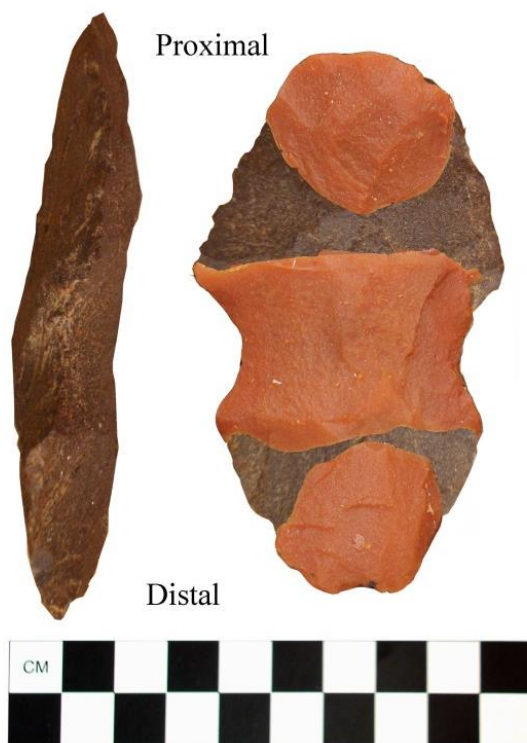


Figure 129. Casting locations on the obverse side of Artifact 003.

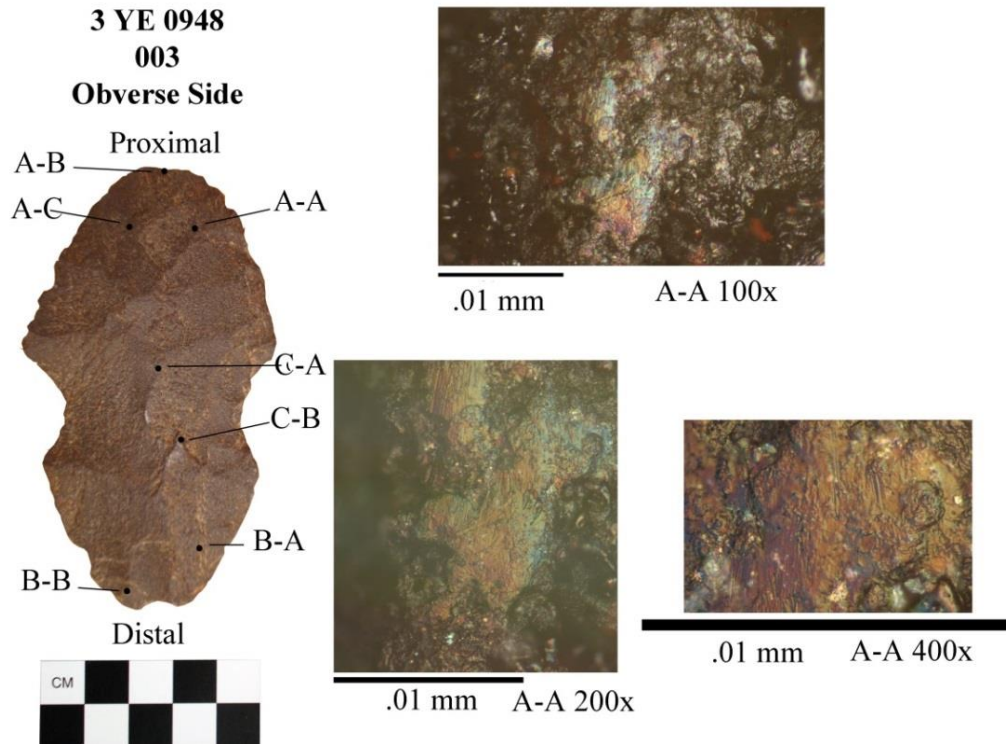


Figure 130. Bit edge wear on obverse side of Artifact 003, Location A-A, showing additive and abrasive wear, with microplating and striations running perpendicular to the tool edge.

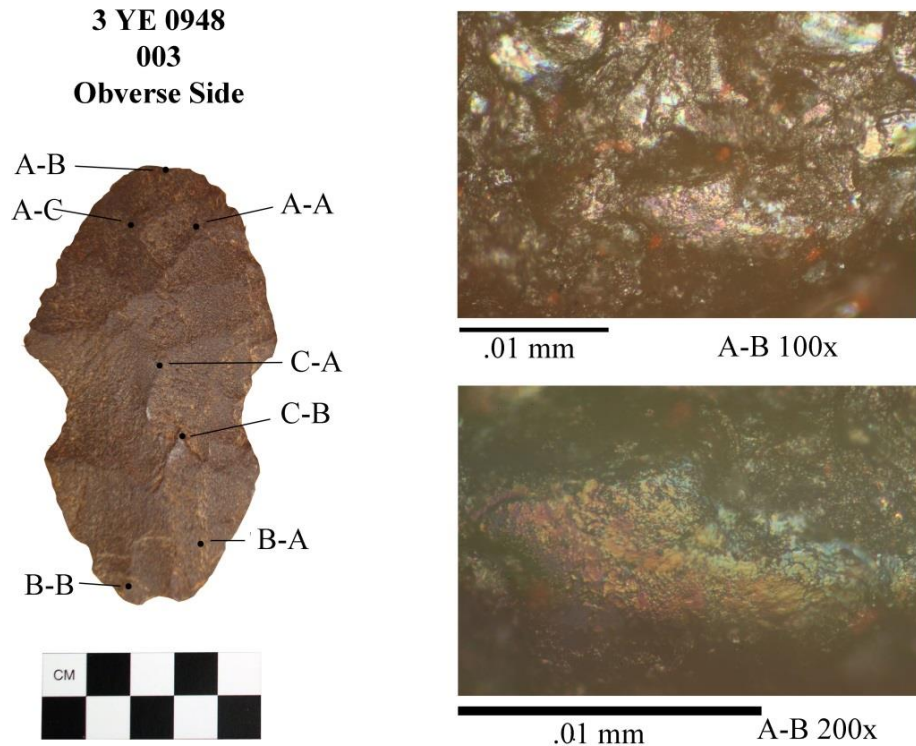
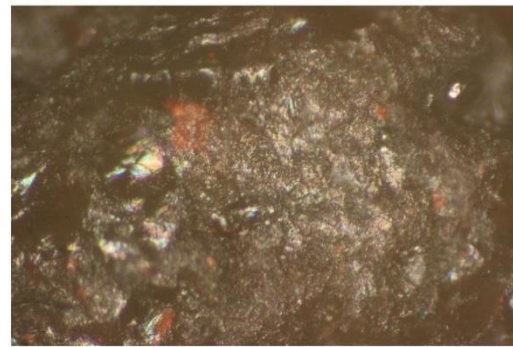
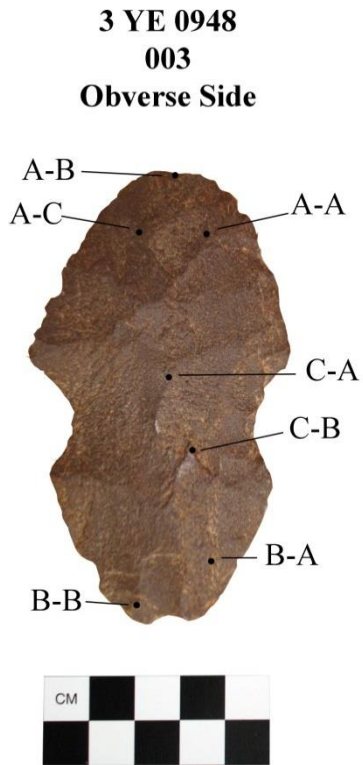
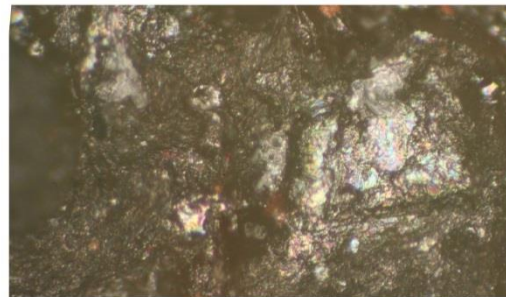


Figure 131. Bit edge wear on the obverse side of Artifact 003, Location A-B, showing abrasive microplating and light additive wear.



.01 mm

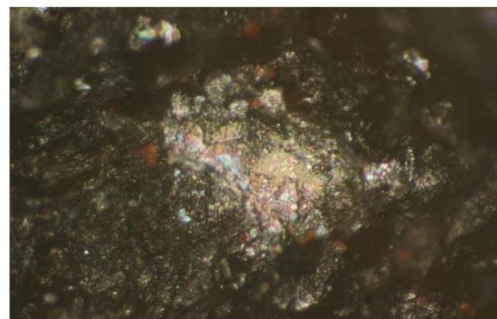
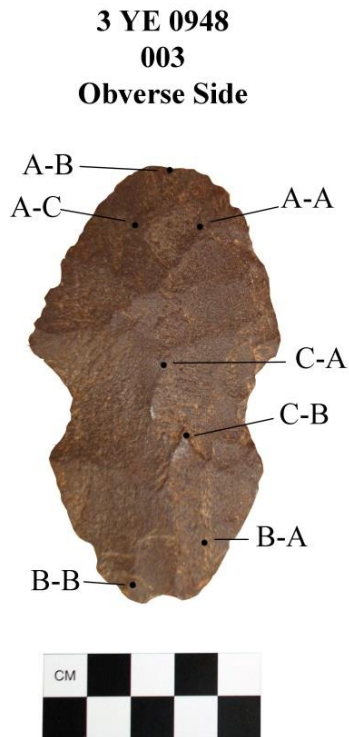
A-C 100x



.01 mm

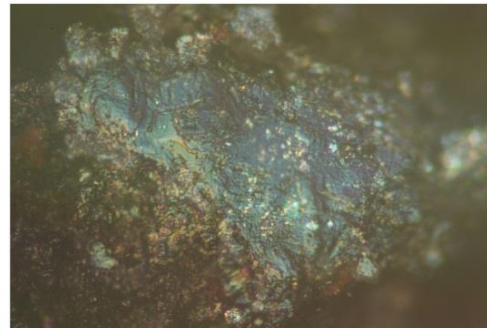
B-A 100x

Figure 132. Bit edge wear on the obverse side of Artifact 003, Locations A-C and B-A, showing additive and abrasive wear.



.01 mm

B-B 100x



.01 mm

B-B 200x

Figure 133. Bit edge wear on the obverse side on Artifact 003, Location B-B, showing additive microplating wear.

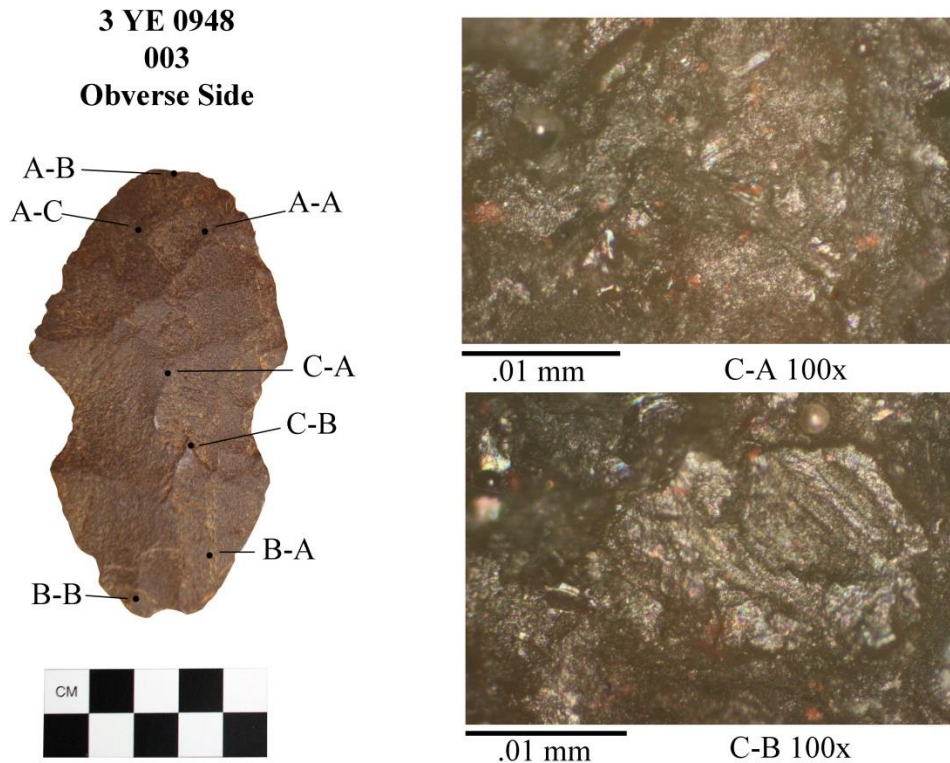


Figure 134. Hafting wear on the obverse side of Artifact 003, Locations C-A and C-B showing additive and generalized abrasive wear.

Artifact 004

Artifact 004 is a damaged double bitted tool with rounded edges made of silicified sandstone (Figure 135). This tool appears to have been created out of a large flake as the reverse side consists of a large flake scar. The hafting portion of the tool shows a light polish and the proximal edge has evidence of light grinding. The distal end of the tool is heavily battered and a corner of the tool is damaged and missing. Artifact 004 weighs 142.5 grams with a length of 102.0 mm, a width of 58.3mm, a hafting width of 40.0 mm and maximum thickness of 22.4 mm

Casting

All three casts taken of Artifact 004, a proximal (A), a partial haft (C) and a full haft (C) were taken from the obverse side. Cast # 10, obverse proximal was produced from Batch 9 and measures 36.04 mm in length and 44.78 mm in width. Cast # 11 is a partial haft, taken from only

one side of the haft and measures 25.7 mm in length and 30.52 mm in width. Cast #12 is the full obverse side of the hafting portion and it is 38.06 mm in length and 27.26 mm in width (Figure 136).

Use-wear

Wear on Artifact 004 consists on both additive and abrasive wear. This tool has fairly substantial wear with large areas of microplating and striation abrasion. This tool has multiple locations where previous striations can be seen being filled in with silica. Hafting wear show abrasion and additive wear, with locations of striations where particles were trapped in the hafting (Figures 137-141).

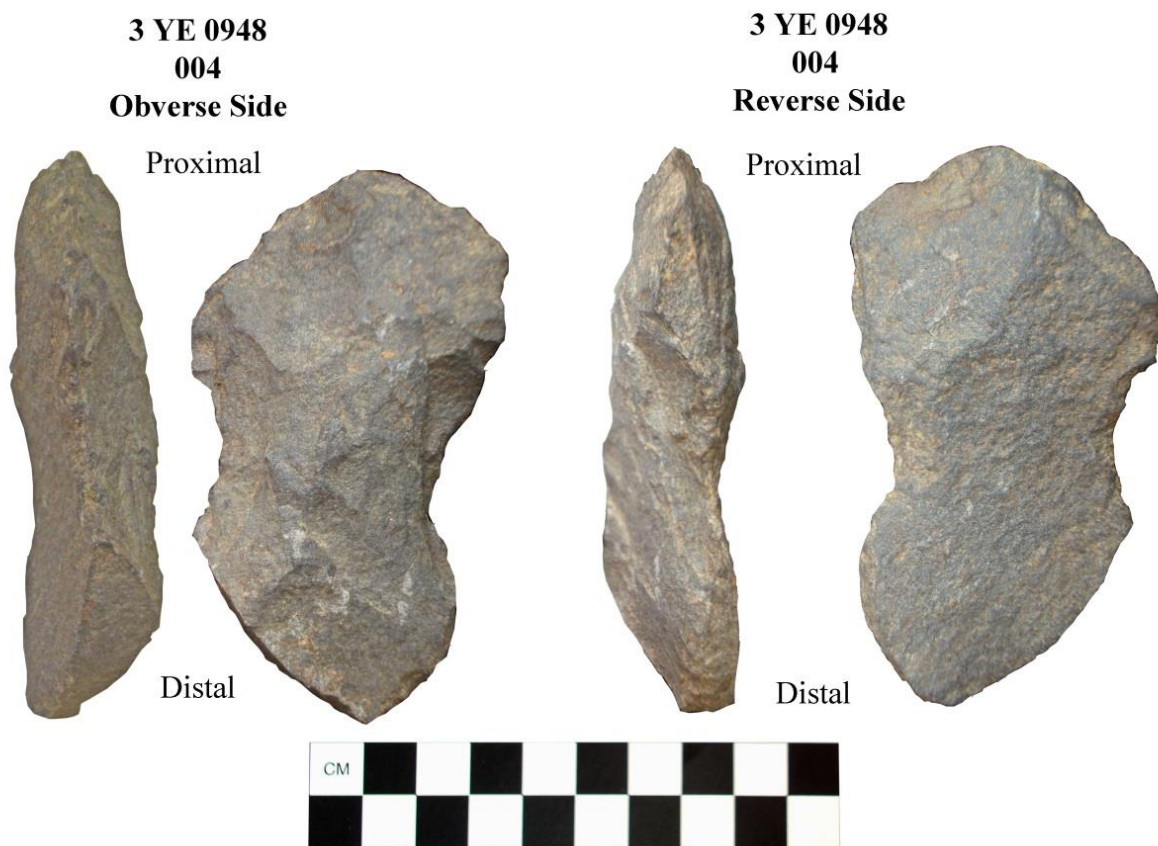


Figure 135. The obverse and reverse sides of Artifact 004.

**3 YE 0948
004
Obverse Side**

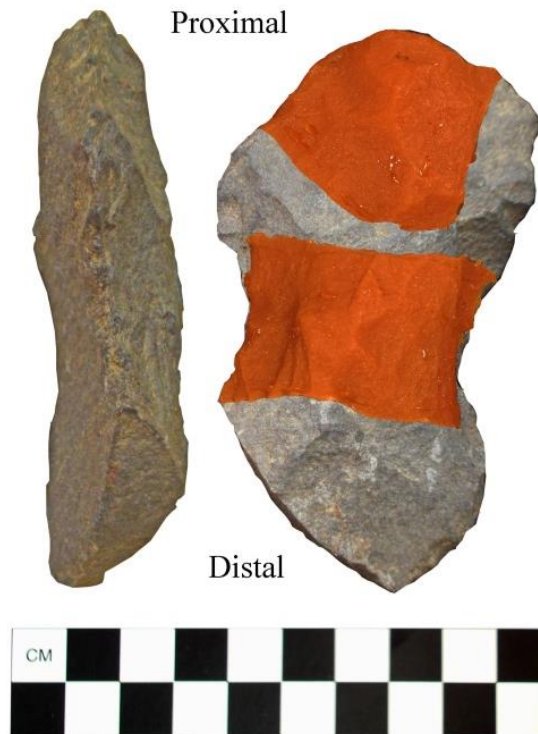


Figure 136. Cast locations on the obverse side of Artifact 004.

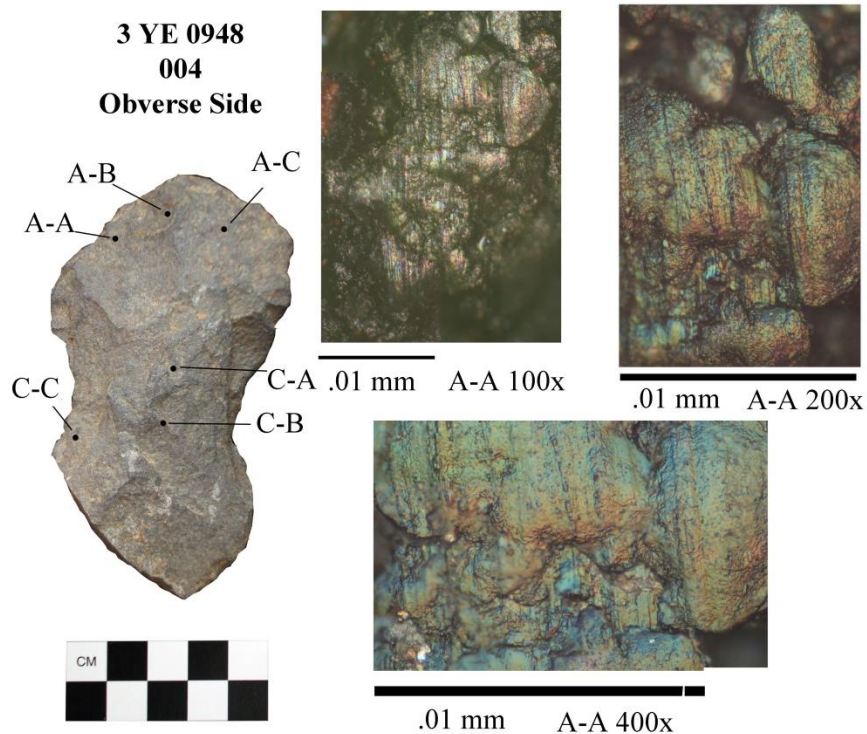


Figure 137. Bit edge wear on the obverse side of Artifact 004, Location A-A, showing both additive and abrasive wear. Microplating is present, as well as filled in striations and newer surface striations, which run perpendicular to the bit edge.

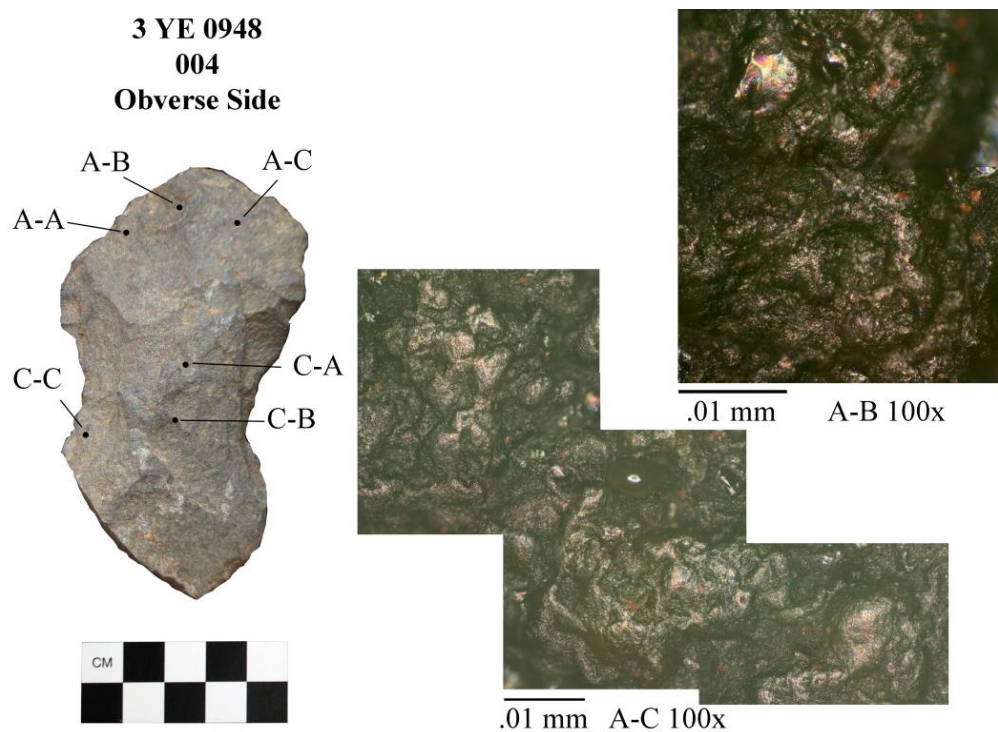


Figure 138. Bit edge wear on obverse side of Artifact 004, Locations A-B and A-C, showing additive and light abrasive wear.

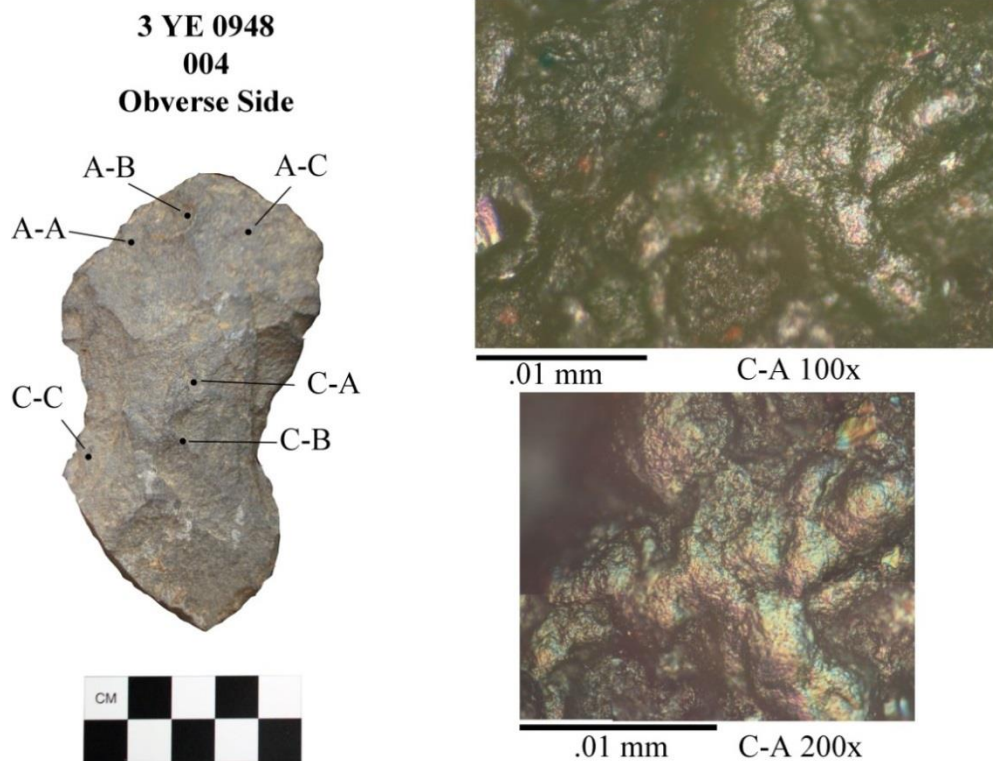


Figure 139. Hafting wear on obverse side of Artifact 004, Location C-A, showing additive and light abrasive wear.

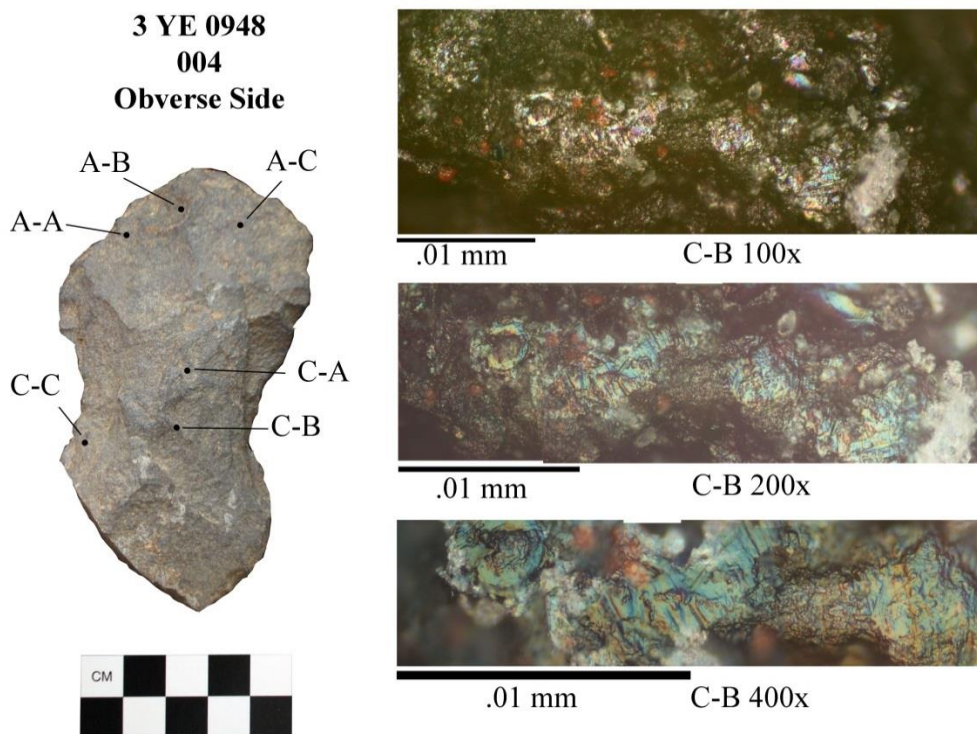


Figure 140. Hafting wear on obverse side of Artifact 004, Location C-B, showing additive microplating and partial filled in striation wear.

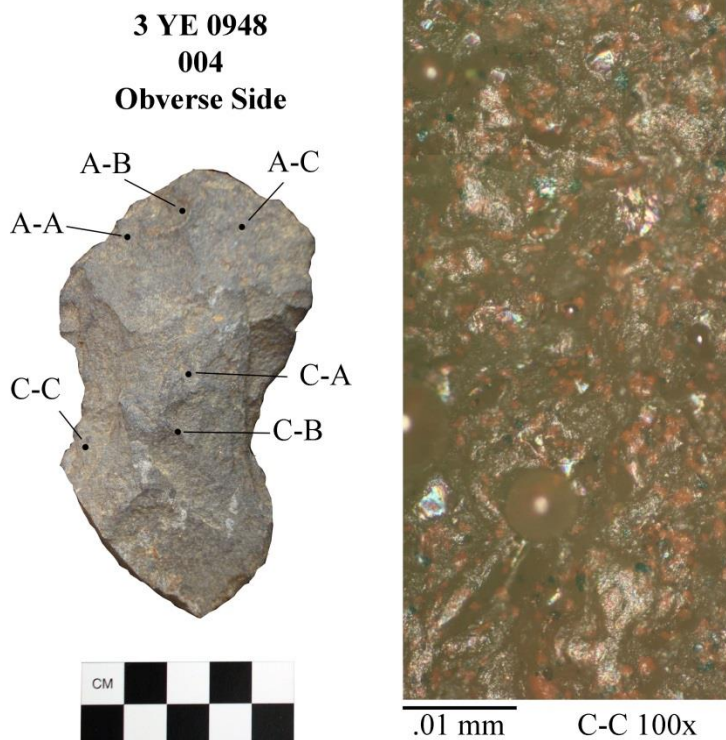


Figure 141. Hafting wear on obverse side on Artifact 004, Location C-C, showing light abrasive wear and cast error in the form of an air bubble.

Artifact 005

Artifact 005 is a damaged double bitted tool with rounded edges made from finely grained silicified sandstone (Figure 142). Both edges of the tool are damaged from use. The proximal edge of the tool was damaged prehistorically and is now missing, possibly due to heat damage. The distal end is damaged mostly likely from use as this end consists of a large step fracture, which probably occurred during re-sharpening or modification of the tool. The intact surfaces show evidence of smoothing near both edges and in the hafting portion; however, the notches do not show evidence of significant smoothing. Artifact 005 has a mass of 185.0 grams with a length of 98.9 mm, a width of 70.4 mm, a hafting width of 49.5 mm and a maximum thickness of 25.9 mm.

Casting

Artifact 005 had two casts taken, a proximal (D) and a haft (F) location, both of which are located on the reverse side. Cast #13, the reverse proximal was taken from Batch 5 with a length of 22.92 mm and a width of 37.44 mm. Cast #14, the reverse haft was created from Batch 6 and measures 49.94 mm in length and 37.5 mm in width (Figure 143).

Use-wear

Artifact 005 has both abrasive and additive wear. Bit wear consists of heavy common microplating wear with few striations of which are in the process of being filled in. Hafting wear has distinct microplating with few light and partially filled in striations and some light generalized abrasion (Figures 144-147).



Figure 142. The obverse and reverse sides of Artifact 005.

3 YE 0948
005
Reverse Side



Figure 143. Cast locations on the reverse side of Artifact 005.

3 YE 0948
005
Reverse Side

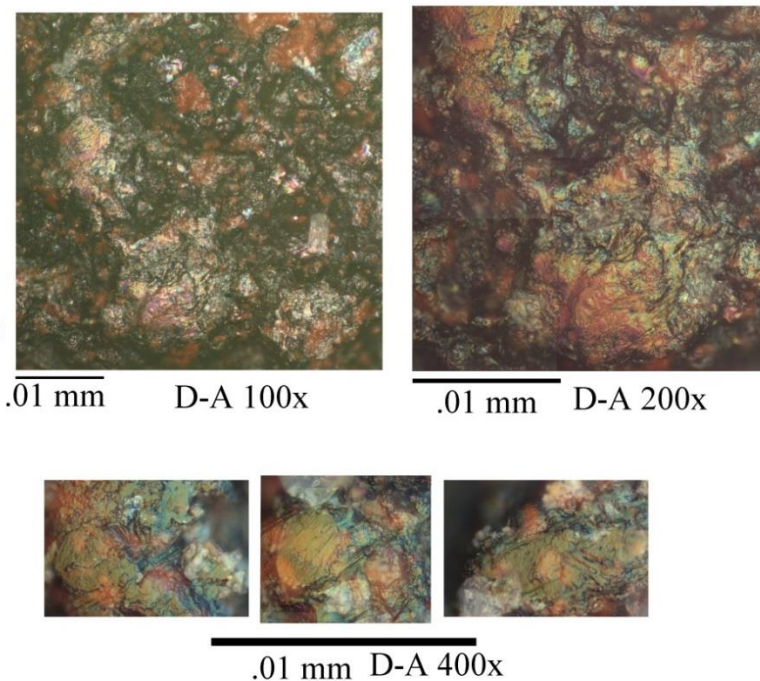
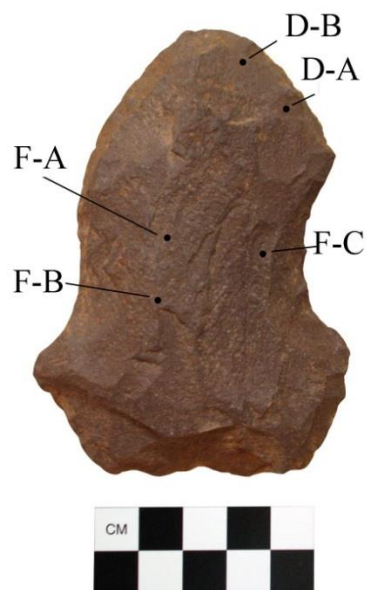


Figure 144. Bit edge wear on the reverse side of Artifact 005, Location D-A, showing both additive and abrasive wear.

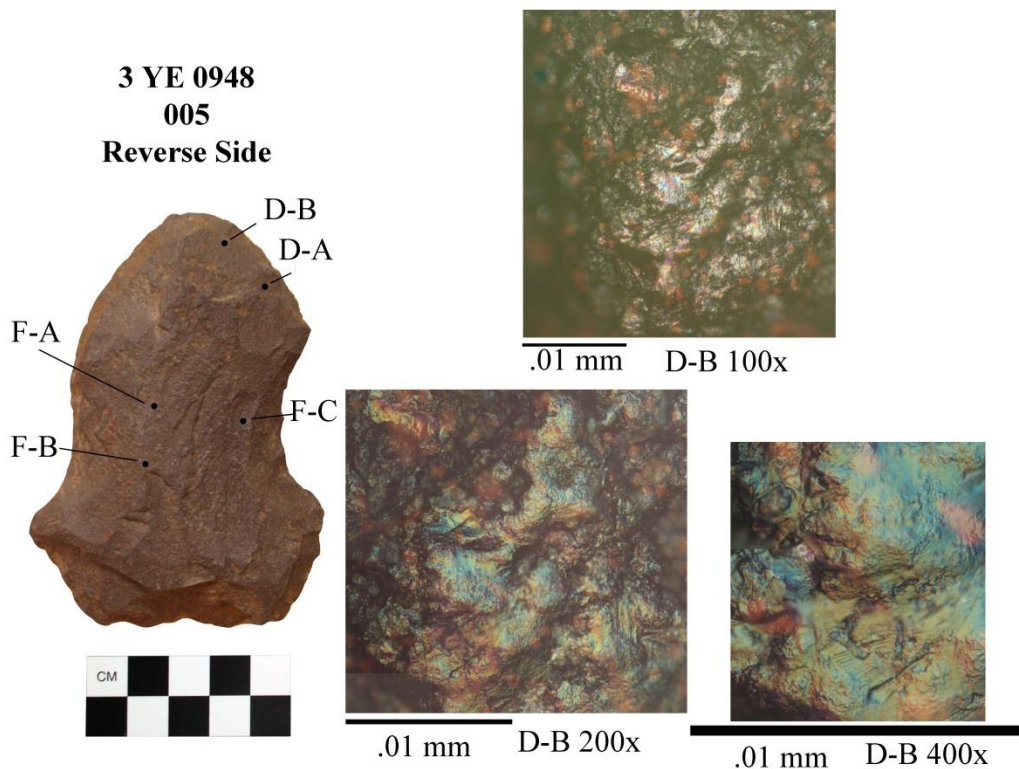


Figure 145. Bit edge wear on the reverse side of Artifact 005, Location D-B, showing both additive and abrasive wear, with large portions of microplating and filled in straitions.

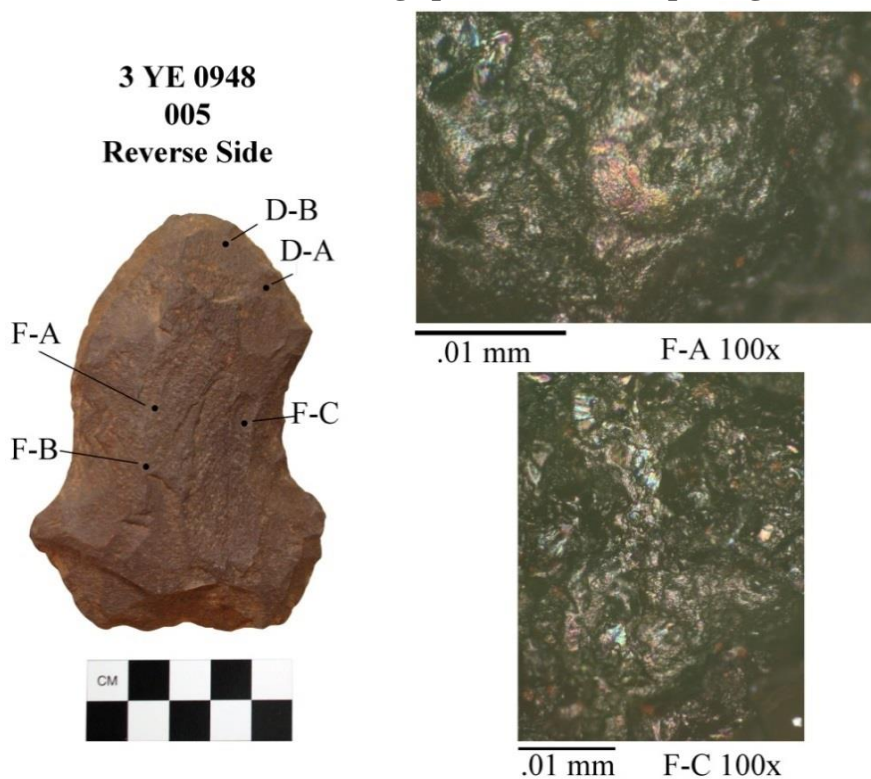


Figure 146. Hafting wear on the reverse side of Artifact 005, Locations F-A and F-C, showing abrasive and additive wear.

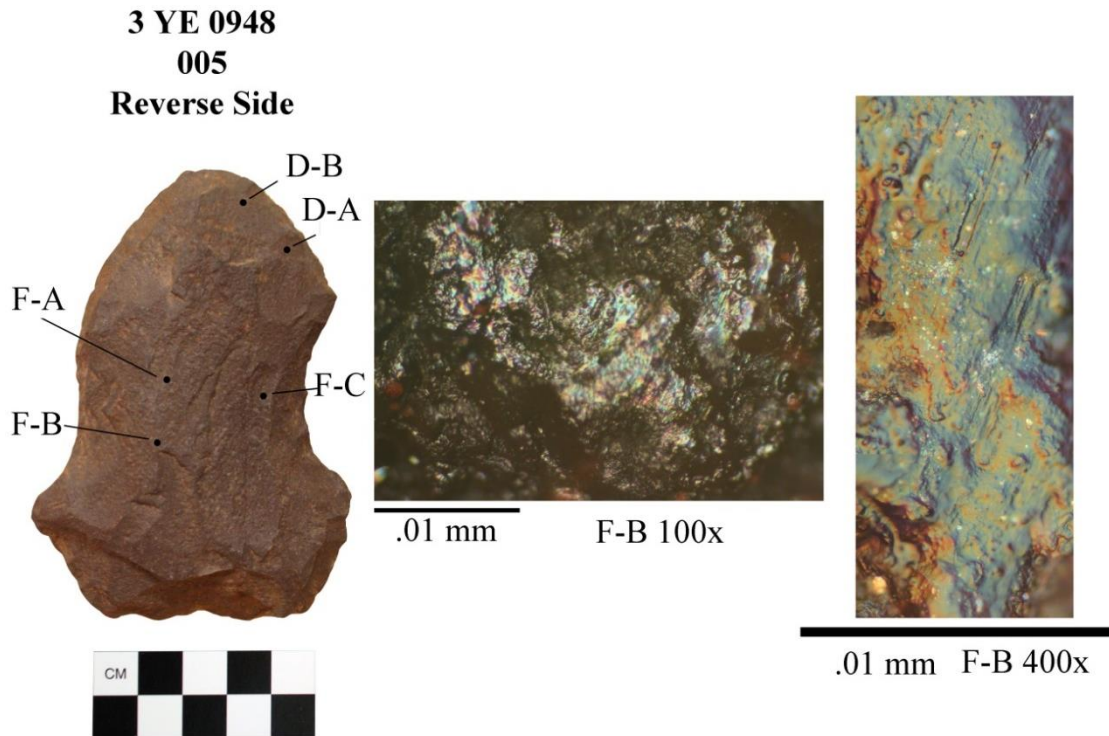


Figure 147. Hafting wear on the reverse side of Artifact 005, Location F-B, showing large portion of microplating and striations.

Artifact 006

Artifact 006 is a double bitted tool made of silicified sandstone with quartz inclusions (Figure 148). Both edges of the tool are intact, but appear to have heavy use with the proximal edge showing evidence of re-sharpening, while the distal edge shows no indication of such activity. Slight grinding evidence can be found on both bit edges. Some evidence can be seen of hafting polish, but the notches do not show much smoothing. Artifact 006 weighs 132.8 grams with a length of 101.7 mm, a maximum width of 55.3 mm and a thickness of 26.5 mm.

Casting

Three casts were obtained from Artifact 006, a proximal (D), a distal (E) and a haft (F), all of which were taken from the reverse side. Cast #15, the reverse proximal, was taken from Batch 7 and measures 28.58 mm in length and 41.0 mm in width. Cast #16, the reverse distal,

was created from Batch 11 and measures 25.79 mm in length and 37.9 mm in width. The reverse haft, Cast #17, was produced from Batch 17 and is 44.71 mm in length and 30.94 mm in width (Figure 149).

Use-wear

Bit wear on Artifact 006 consists of locations with substantial microplating with few small striations running perpendicular to the tool edge and generalized light abrasion (Figures 150-151).



Figure 148. The obverse and reverse sides of Artifact 006.

**3 YE 0948
006
Reverse Side**



Figure 149. Casting locations on the reverse side of Artifact 006.

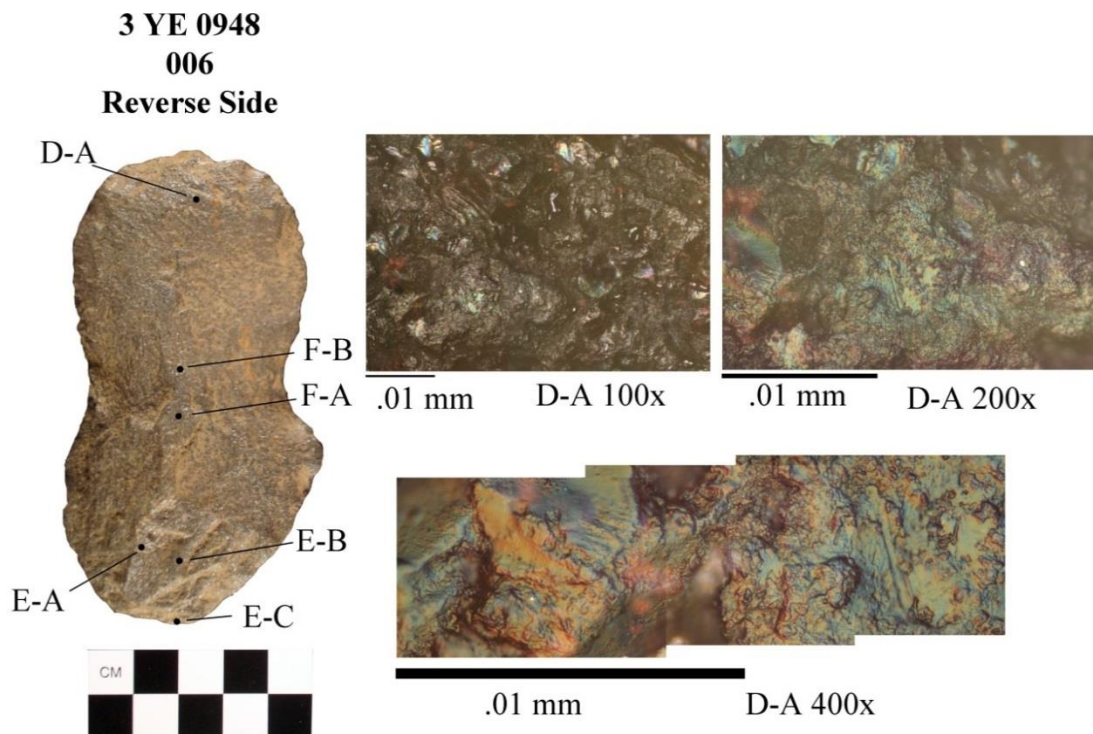


Figure 150. Bit edge wear on the reverse side of Artifact 006, Location D-A, showing additive and abrasive wear.

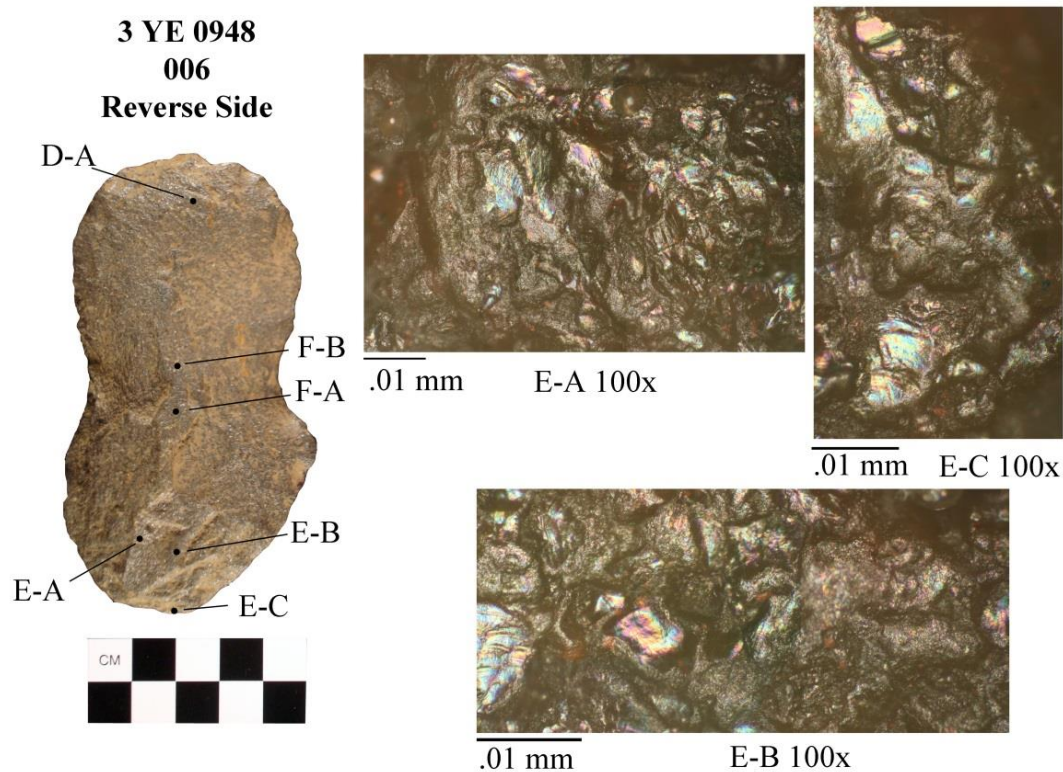


Figure 151. Bit edge wear on the reverse side of Artifact 006, Locations E-A, E-B, and E-C, showing light abrasion and pseudo-wear.

Artifact 007

Artifact 007 is a small double bitted tool made of silicified sandstone (Figure 152). Both edges are rounded and show signs of wear. The proximal edge is heavily battered and ground. The distal edge shows some evidence of re-sharpening and minimal amount of grinding on this edge can also be seen. There is evidence of hafting polish on the higher flake scars on both sides of the tool, and the notches are slightly smoothed. Artifact 007 weighs 118.0 grams with a length of 82.8 mm, a width of 62.7 mm, and a maximum thickness of 19.2 mm.

Casting

Two casts were taken from Artifact 007, an obverse proximal (A) and a reverse haft (F). Cast #18, the obverse proximal was taken from Batch 5. Length was 33.33 mm by 41.8 mm in width. Cast #19, the reverse haft, was taken from Batch 8 and measures 50.44 mm in length and 32.4 mm in width (Figure 153).

Use-wear

Wear on Artifact 007 shows heavy wear. Bit edges show substantial directional microplating wear. Hafting areas has large and consistent microplating wear which experienced abrasive wear prior to abandonment (Figures 154-157).



Figure 152. The obverse and reverse sides of Artifact 007.

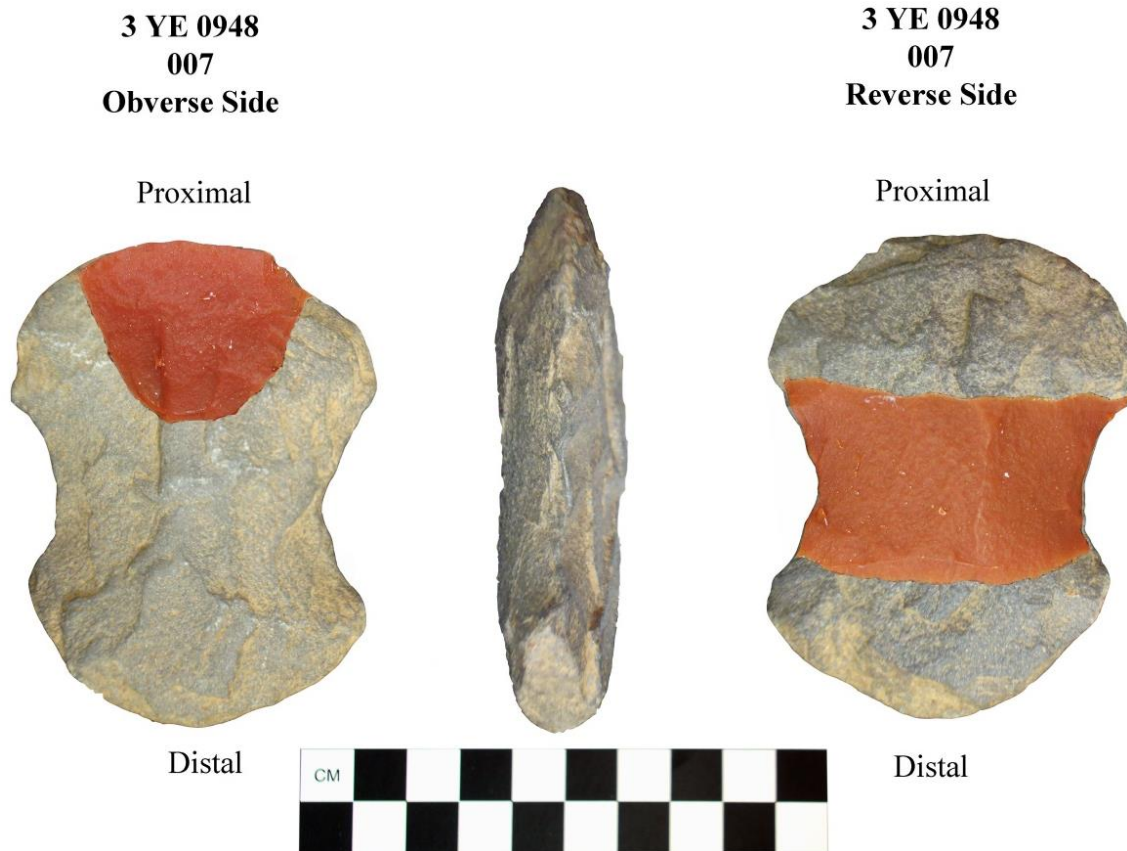


Figure 153. Casting locations on the obverse and reverse sides of Artifact 007.

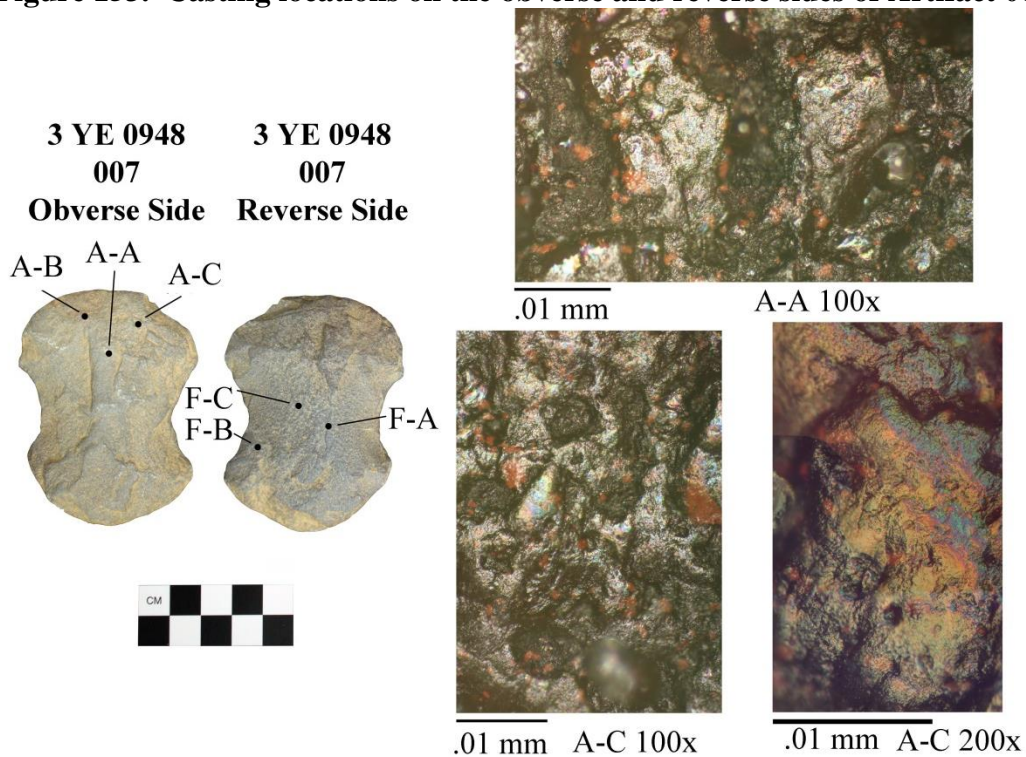


Figure 154. Bit edge wear on the obverse side of Artifact 007, Locations A-A and A-C, showing additive and light abrasive wear.

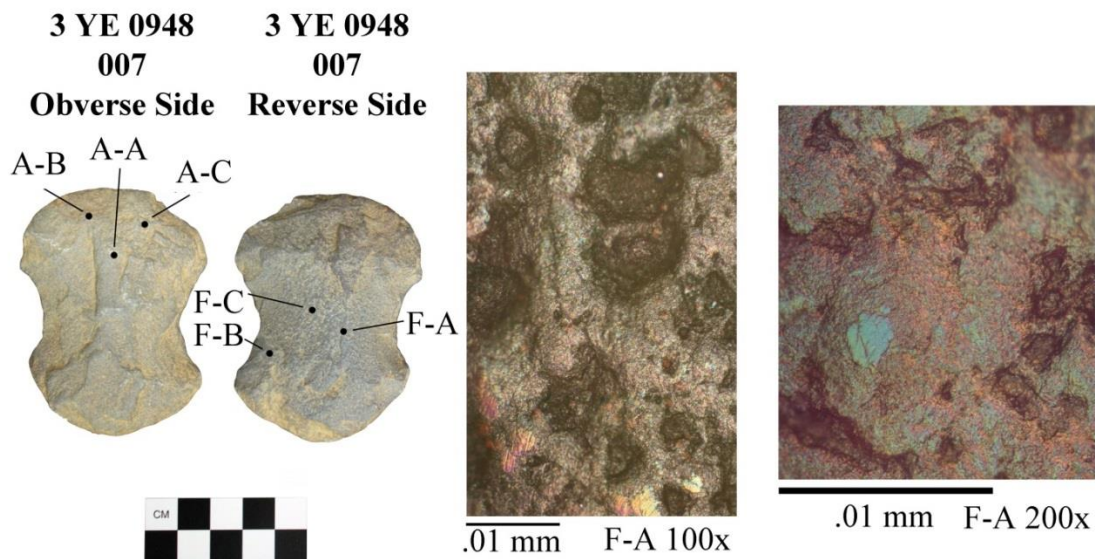


Figure 155. Hafting wear on the reverse side of Artifact 007, Location F-A, showing abrasive and additive wear.

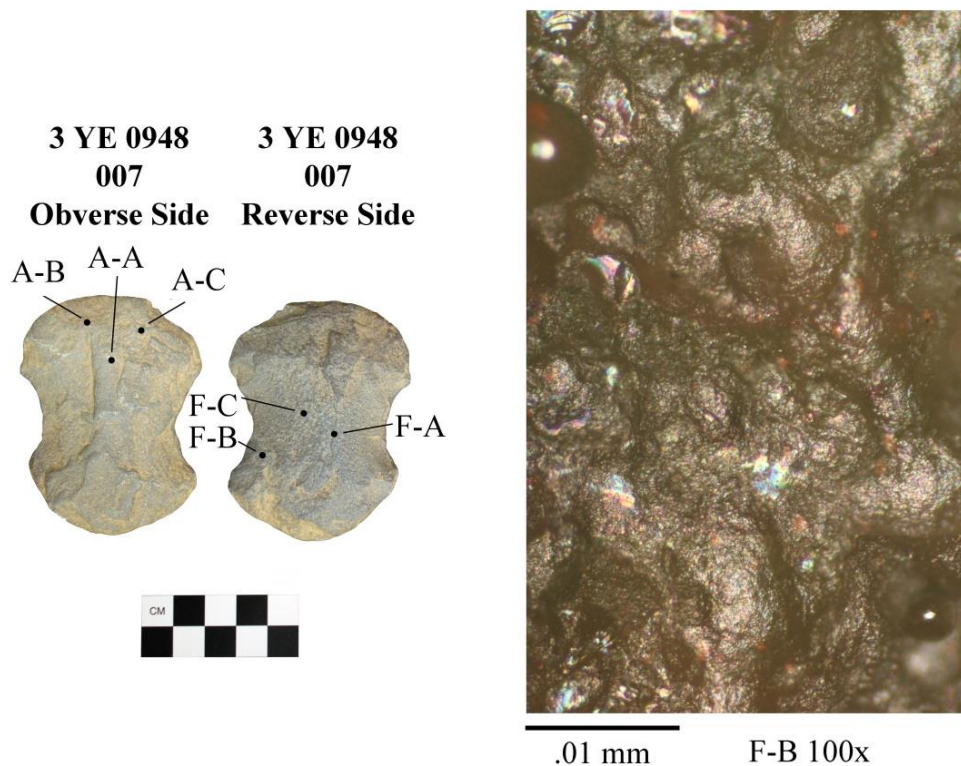


Figure 156. Hafting wear on the reverse side of Artifact 007, Location F-B, showing abrasive wear with the beginnings of microplating.

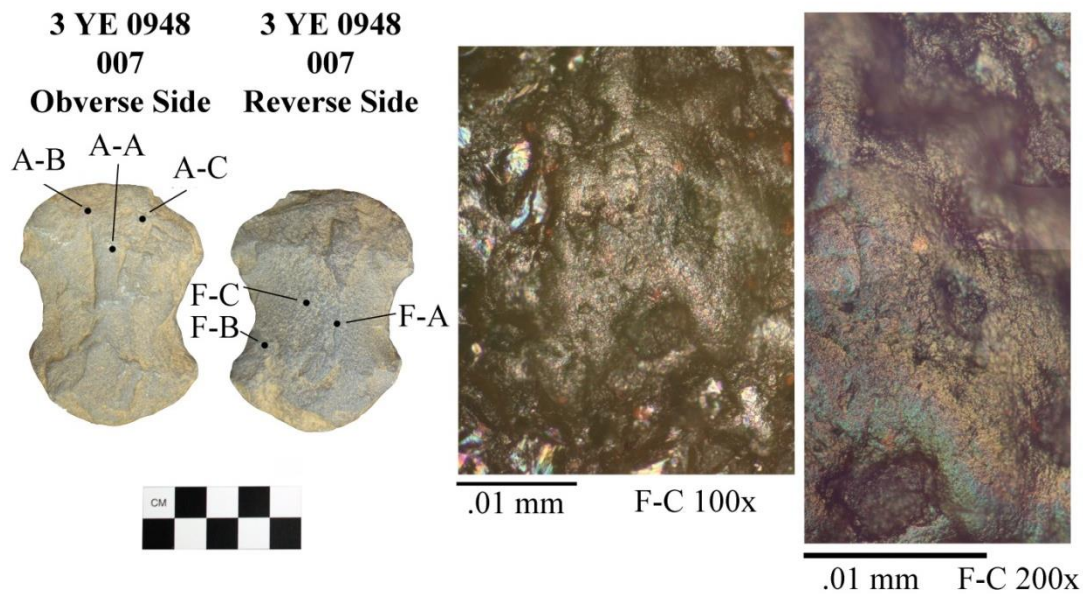


Figure 157. Hafting wear on the reverse side of Artifact 007, Location F-C, showing additive wear and light abrasive wear.

Artifact 008

Artifact 008 is an elongated tool with evidence of a slight hafting location (Figure 158). The tool is complete and is made of grey silicified sandstone. There is clear evidence of hafting wear on the reverse side of the tool. Both ends are heavily damaged with large flakes removed. The notches contain heavy wear and are smoothed to the point of barely being present. The bits are worn down considerably; the edges are well rounded. Edges are sharp with little grinding or smoothing present. Artifact 008 weighs 167.6 grams with a length of 100.0 mm, a maximum width of 47.6 mm and a thickness of 33.9 mm.

Casting

A total of three casts were taken from Artifact 008, an obverse proximal (A), a obverse distal (B) and a reverse haft (F). Cast #20, the obverse proximal was cast from Batch 3. Length was 26.35 mm and width was 40.77mm. Cast #21, the obverse distal, was taken from Batch 2.

Length was 27.12 mm and width was 36.35 mm. Cast #22, a reverse haft, was taken from Batch 8 and measures 40.82 mm in length and 38.0 mm in width (Figure 159).

Use-wear

Bit edge wear on Artifact 008 consisted of generalized abrasion and a few locations of microplating with multi-directional striations. This wear is most likely due to attempted re-sharpening of the tool. Hafting wear on this tool is slightly unique to the collection, as it is one of the tools which have obvious hafting polish. Wear here consists of microplating with small multi-directional striations many of which are partially filled in (Figures 160-165).

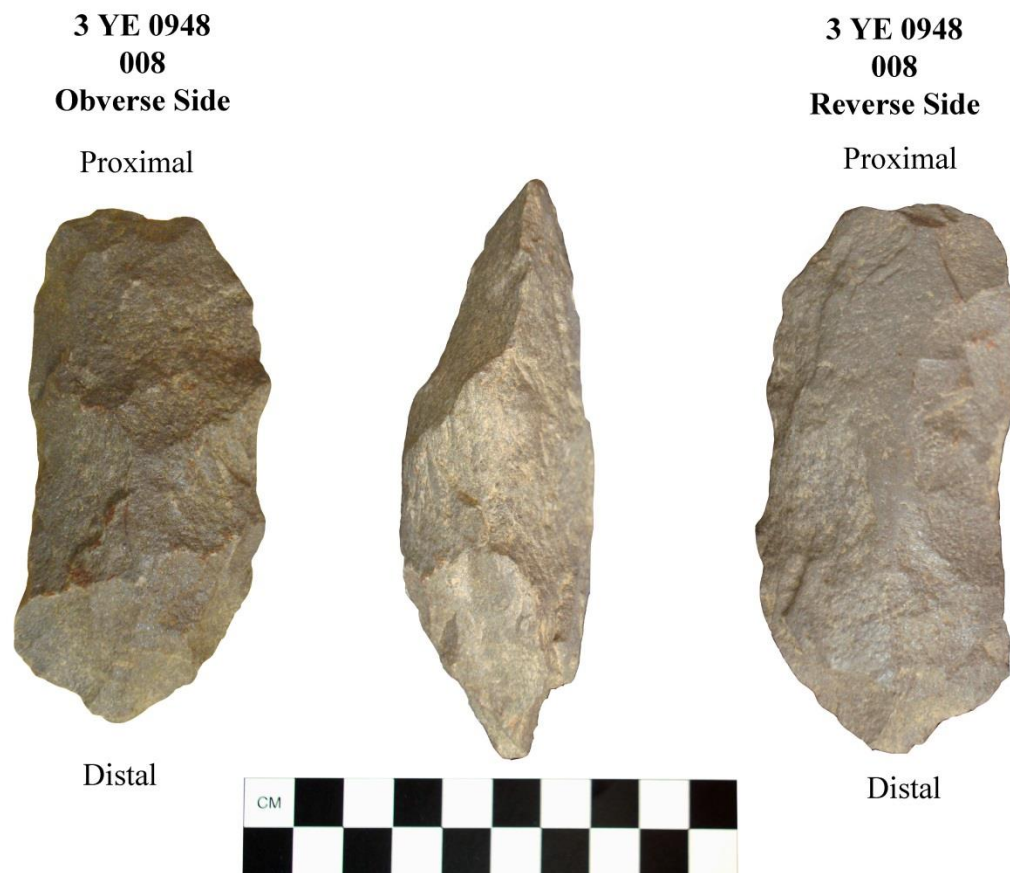


Figure 158. The obverse and reverse sides of Artifact 008.

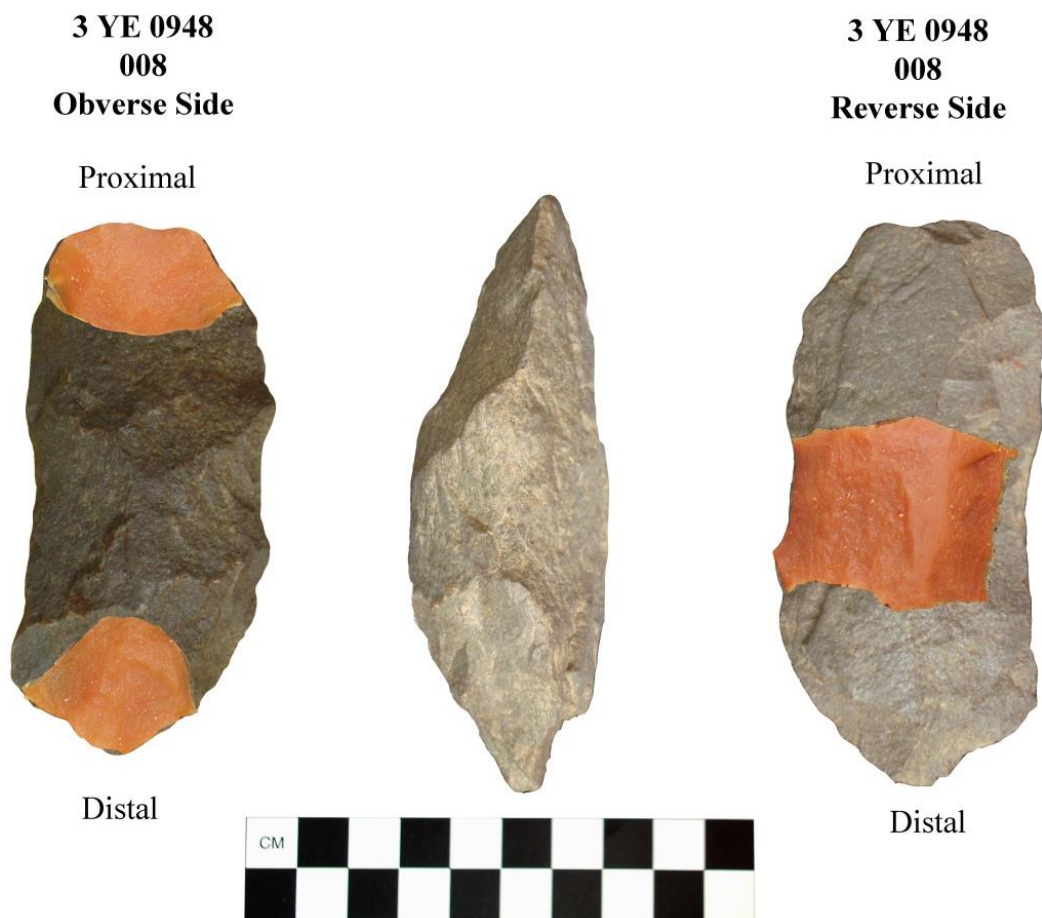


Figure 159. Casting locations on the obverse and reverse sides of Artifact 008.

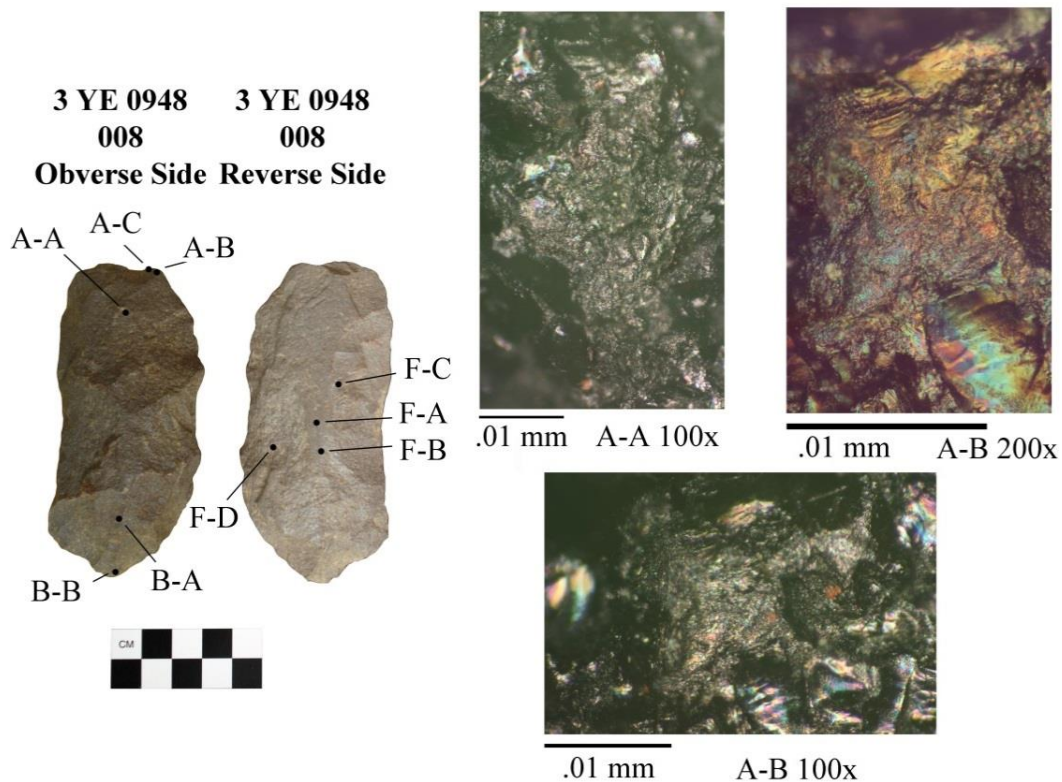


Figure 160 . Bit edge wear on the obverse side of Artifact 008, Locations A-A and A-B, showing generalized abrasion and light additive wear.

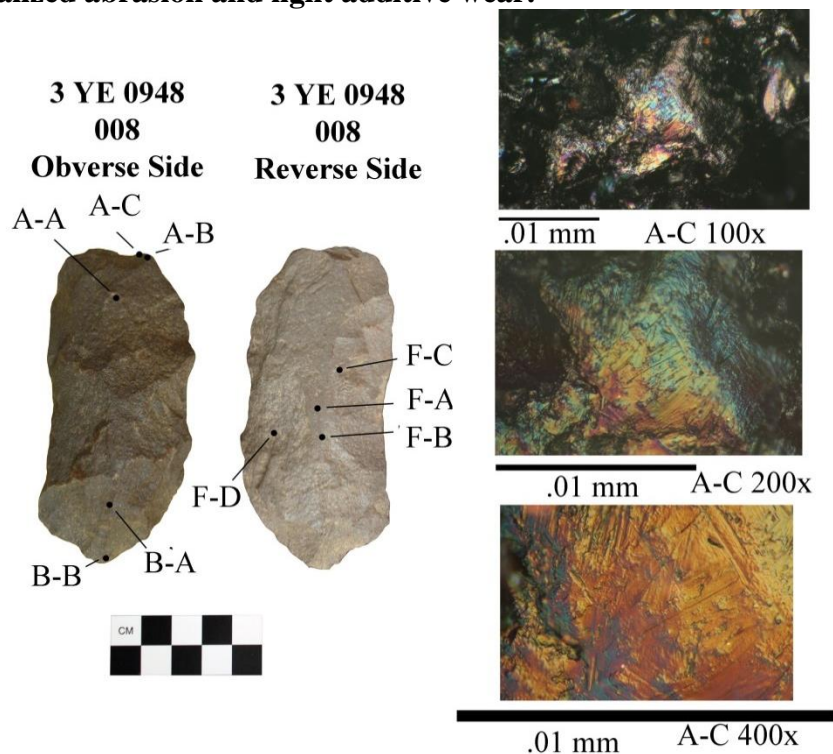


Figure 161. Bit edge wear on the obverse side of Artifact 008, Location A-C, showing microplating wear with numerous multi-directional striations.

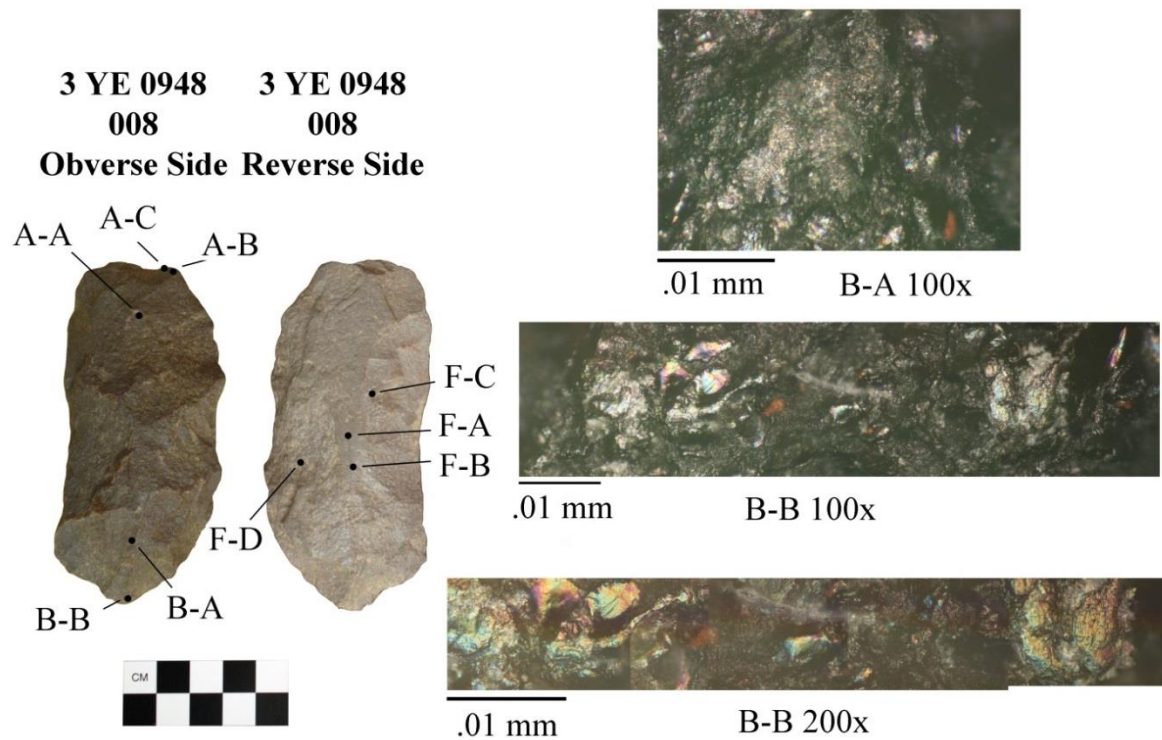


Figure 162. Bit edge wear on the obverse side of Artifact 008, Locations A-B and B-B, showing generalized abrasion and microplating wear.

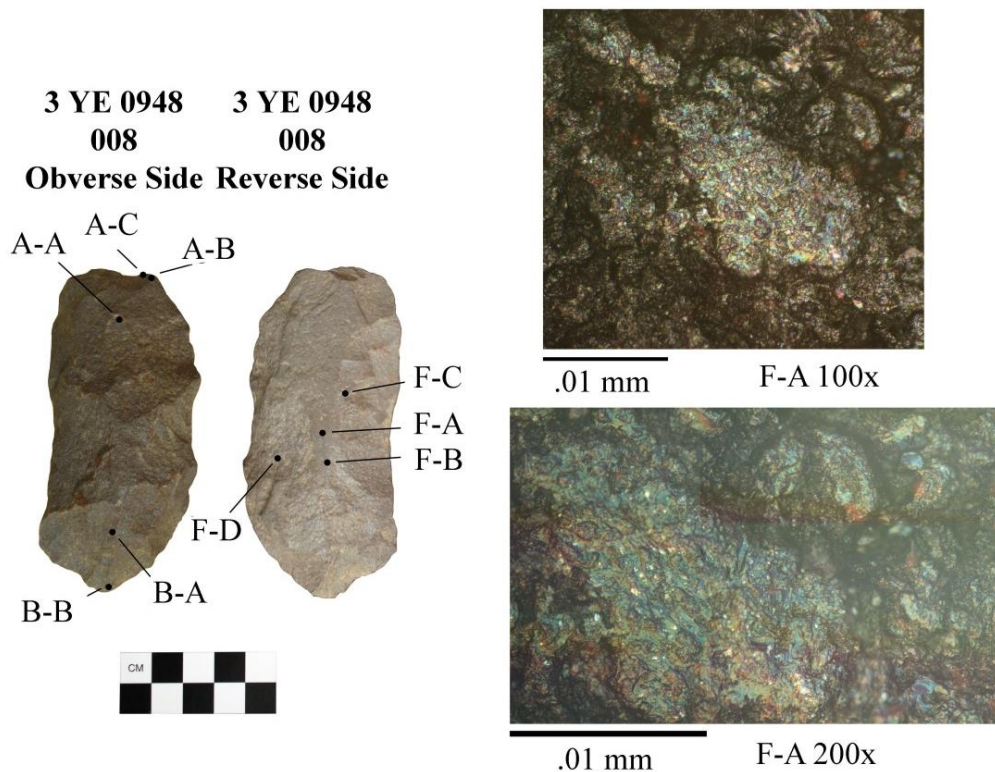


Figure 163. Hafting wear on the reverse side of Artifact 008, showing microplating wear with few multi-directional striations.

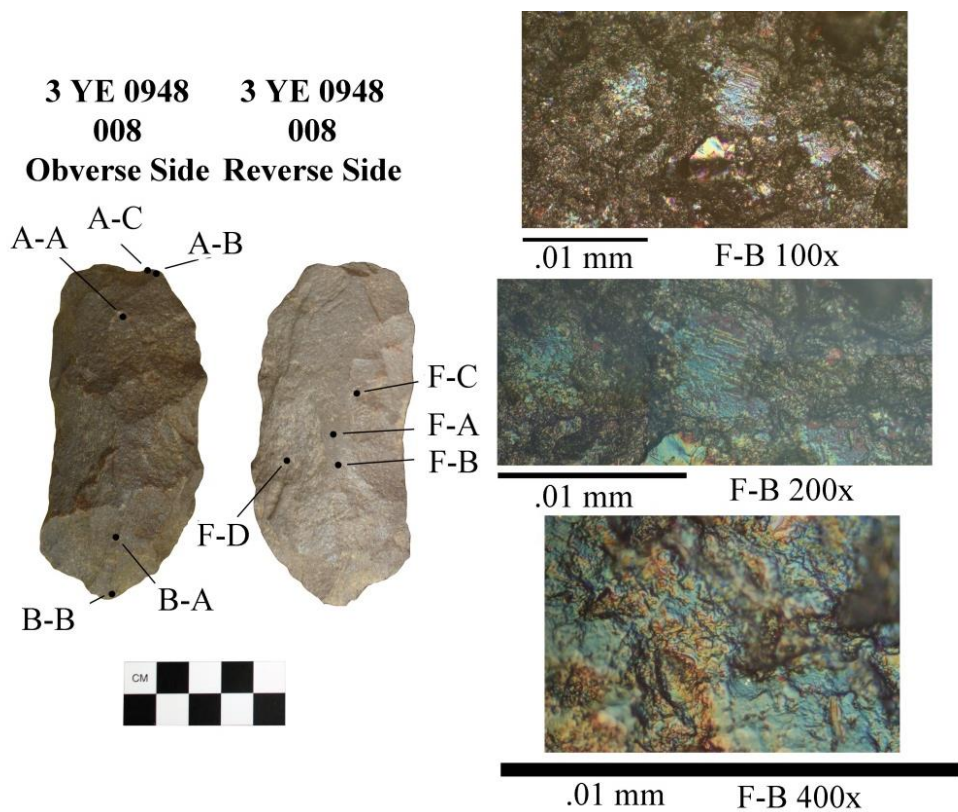


Figure 164. Hafting wear on the reverse side of Artifact 008, Location F-B, showing heavy microplating wear with multi-directional striations.

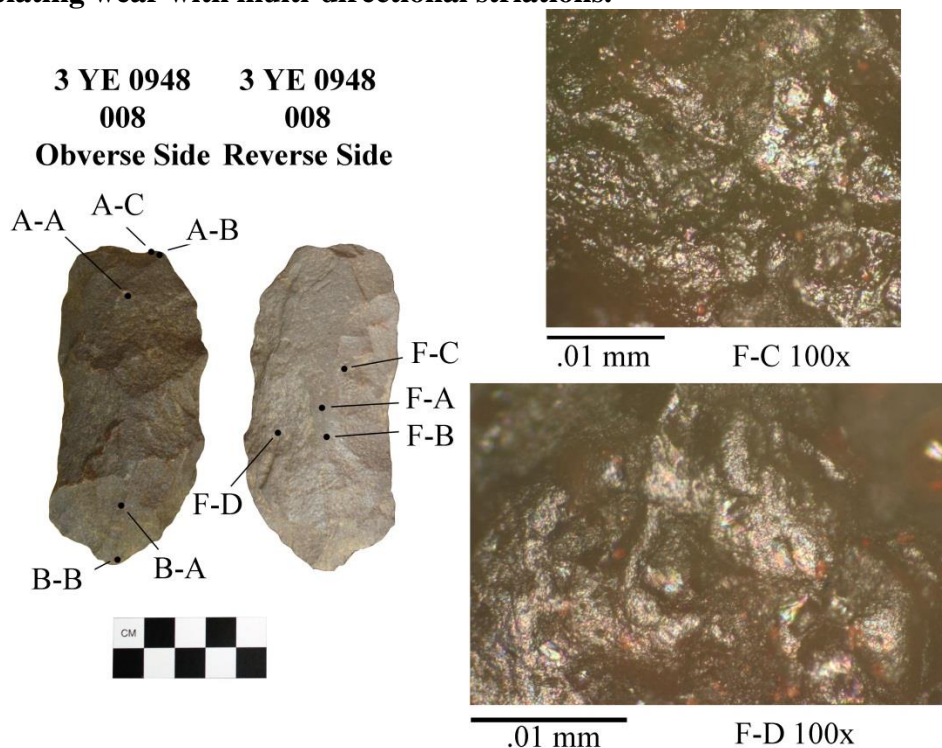


Figure 165. Hafting wear on the reverse side of Artifact 008, Locations F-C and F-D, showing generalized abrasive wear with the beginnings of additive wear.

Artifact 009

Artifact 009 is a complete double bitted tool with triangular edges made of silicified sandstone (Figure 166). Obverse side of the tool has very little knapping work done on it; the tool appears to have been made from a large primary flake. Artifact shows little evidence of wear and is possibly a newly knapped tool. Edges show no evidence of grinding or smoothing, either on the bit or on the hafting edges. Artifact 009 weighs 136.4 grams and measures 122.7 mm in length, 58.7 mm in width and has a maximum thickness of 17.8 mm.

Casting

Three casts were taken from Artifact 009, a proximal (D), distal (E) and haft (F), all from the reverse side of the tool. Cast # 23, the reverse proximal, was created out of Batch 12 and measures 34.57 mm in length and 42.06 mm in width. The reverse distal, Cast #24, was produced from Batch 9 and measured 29.73 mm in length and 35.32 mm in width. Cast #25, the reverse haft, was made from Batch 7 and is 44.48 mm in length and 35.48 mm in width (Figure 167).

Use-wear

Bit edge wear shows slight microplating with multi-directional striations. Hafting wear consists of heavy microplating with portions of numerous striations running perpendicular to the longitudinal axis of the tool. This wear was most likely caused by particles becoming tapping in the hafting material (Figure 168-172).



Figure 166. The obverse and reverse side of Artifact 009.

3 YE 0948
009
Reverse Side

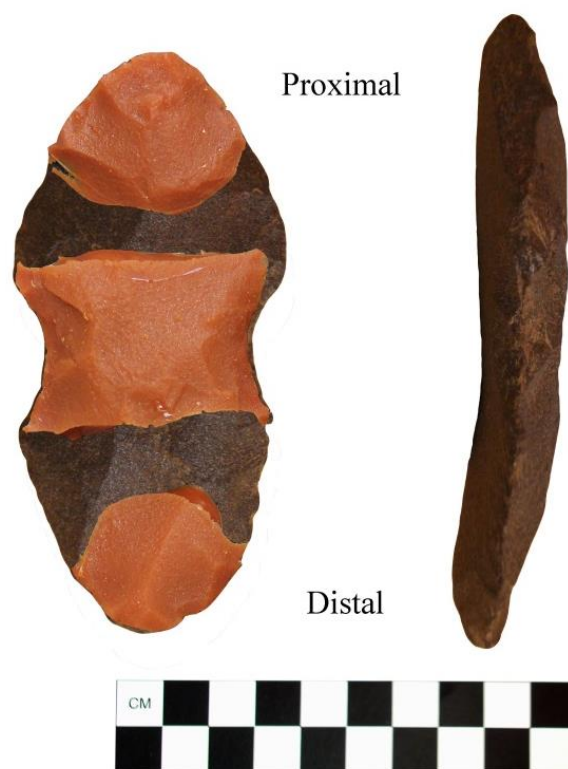


Figure 167. Casting locations on the reverse side of Artifact 009.

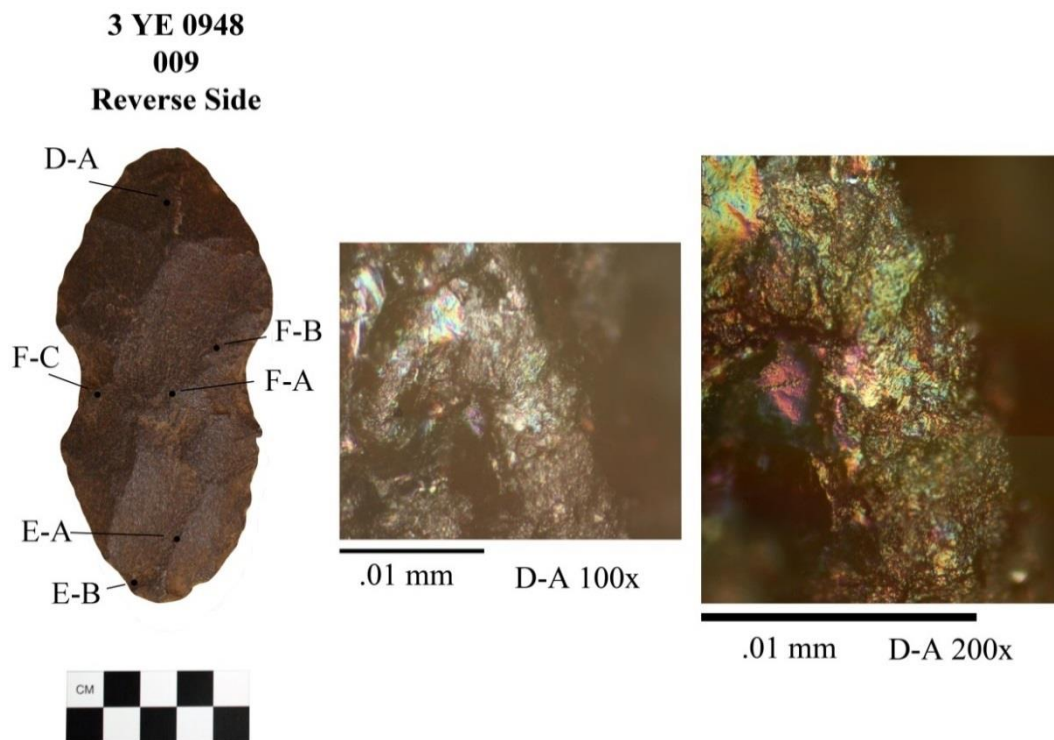


Figure 168. Bit edge wear on the reverse side of Artifact 009, Location D-A, showing generalized wear and the beginnings of microplating wear.

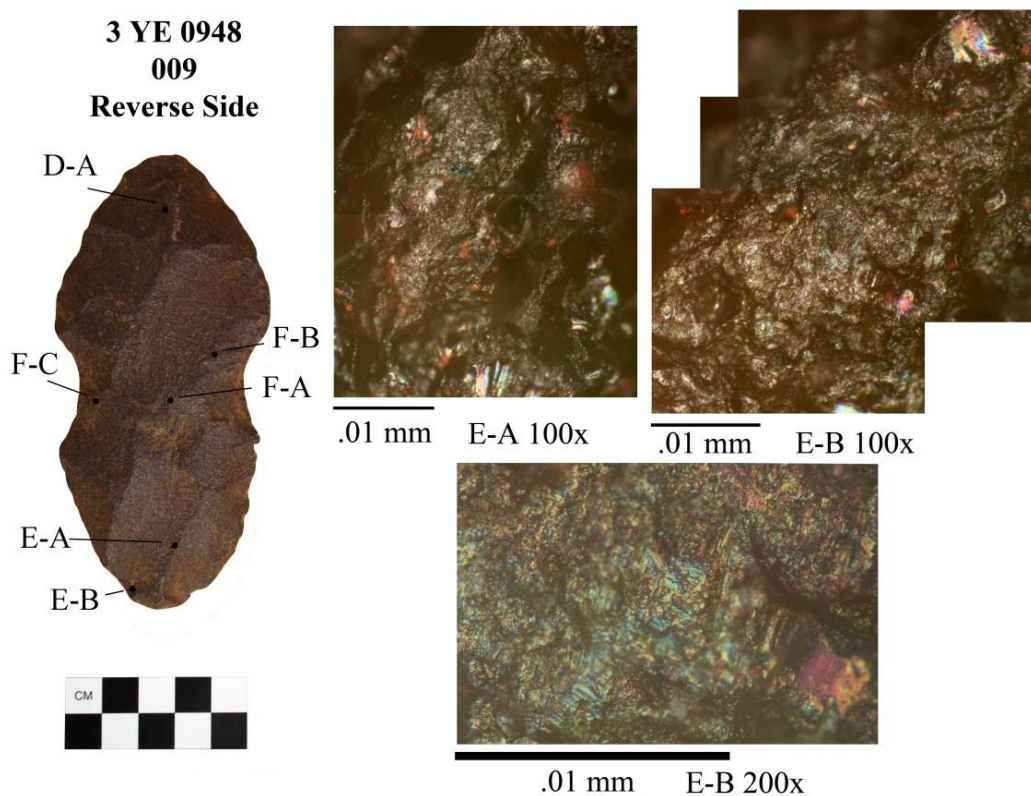


Figure 169. Bit edge wear on the reverse side of Artifact 009, Locations E-A and E-B, showing generalized abrasion, light microplating and multi-directional wear.

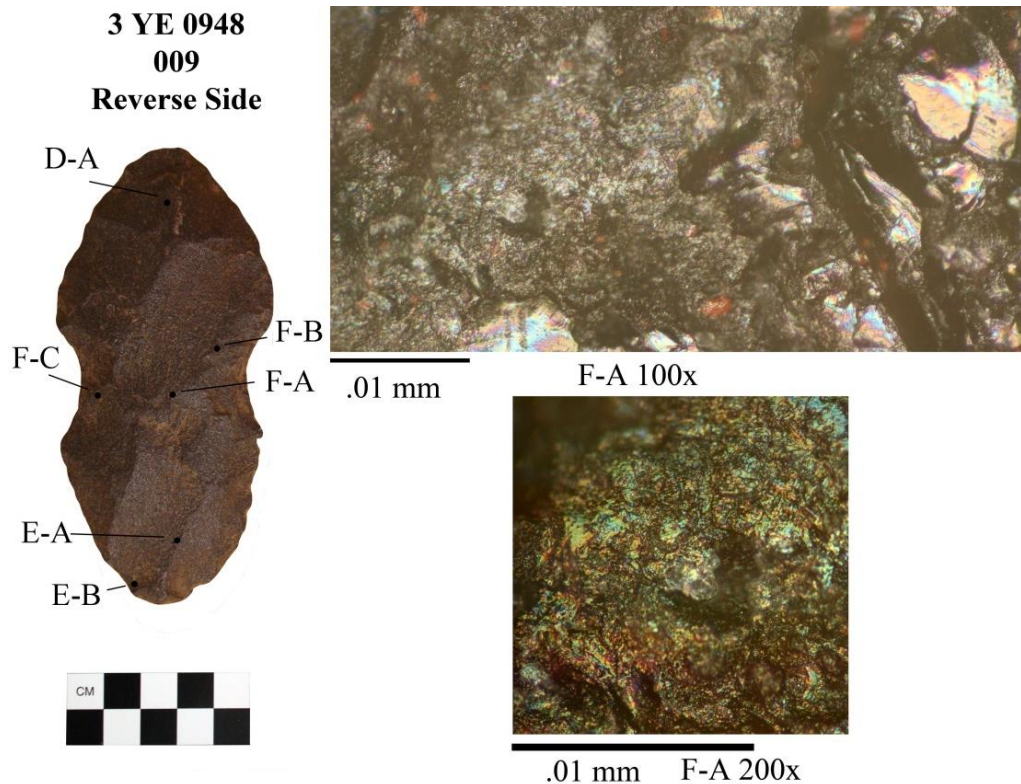


Figure 170. Hafting wear on the reverse side of Artifact 009, Location F-A, showing generalized abrasion and light microplating.

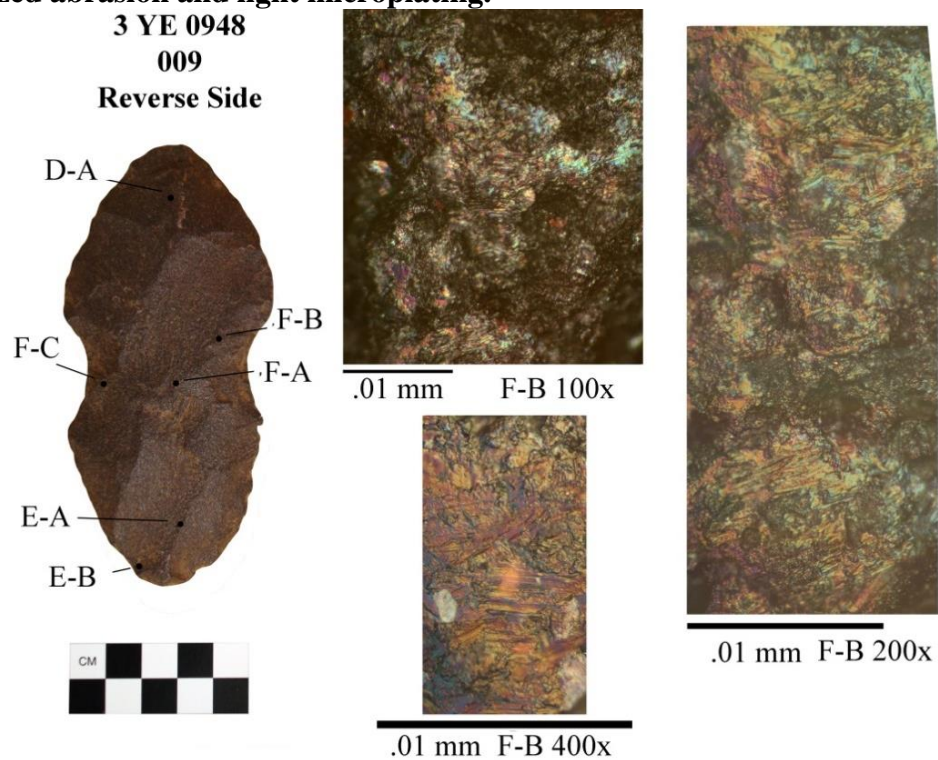


Figure 171. Hafting wear on the reverse side of Artifact 009, Location F-B, showing directional microplating and numerous striations running perpendicular to the tool's longitudinal axis.

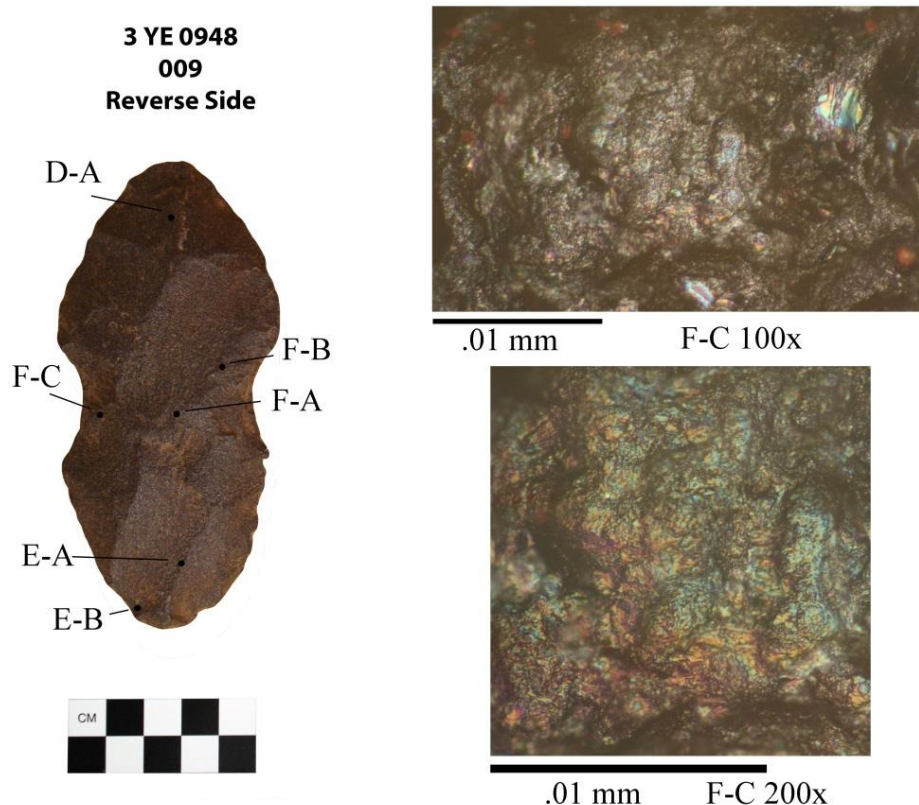


Figure 172. Hafting wear on the reverse side of Artifact 009, Location F-C, showing generalized abrasion and light microplating.

Artifact 010

Artifact 010 is a medium sized complete double bitted tool (Figure 173). Both edges have considerable rounding with light grinding and polish can be seen. A large step fracture is located in the center of the tool, but would not impact how the tool was used. This tool is made of silicified sandstone. Artifact 010 weighs 155.0 grams with a length of 91.8 mm, a maximum width of 72.1 mm and a thickness of 23.8 mm.

Casting

A total of three casts were taken from Artifact 010, a proximal (D), distal (E) and haft (F), all from the reverse side. Cast #26, the reverse proximal was taken from Batch 2, with the length of 27.01 mm by the width of 46.79 mm. Cast #27, the reverse distal, was also taken from

Batch 2. The length was 21.5 mm and width was 36.13 mm. Cast #28, the reverse haft, was produced from Batch 10 and measures 62.5 mm in length and 33.41 mm in width (Figure 174).

Use-wear

Bit edge wear has large portions of plane-like microplating with some additional abrasion on top. The hafting portion of the tool is has numerous locations of microplating and generalized abrasion (Figures 175-177).

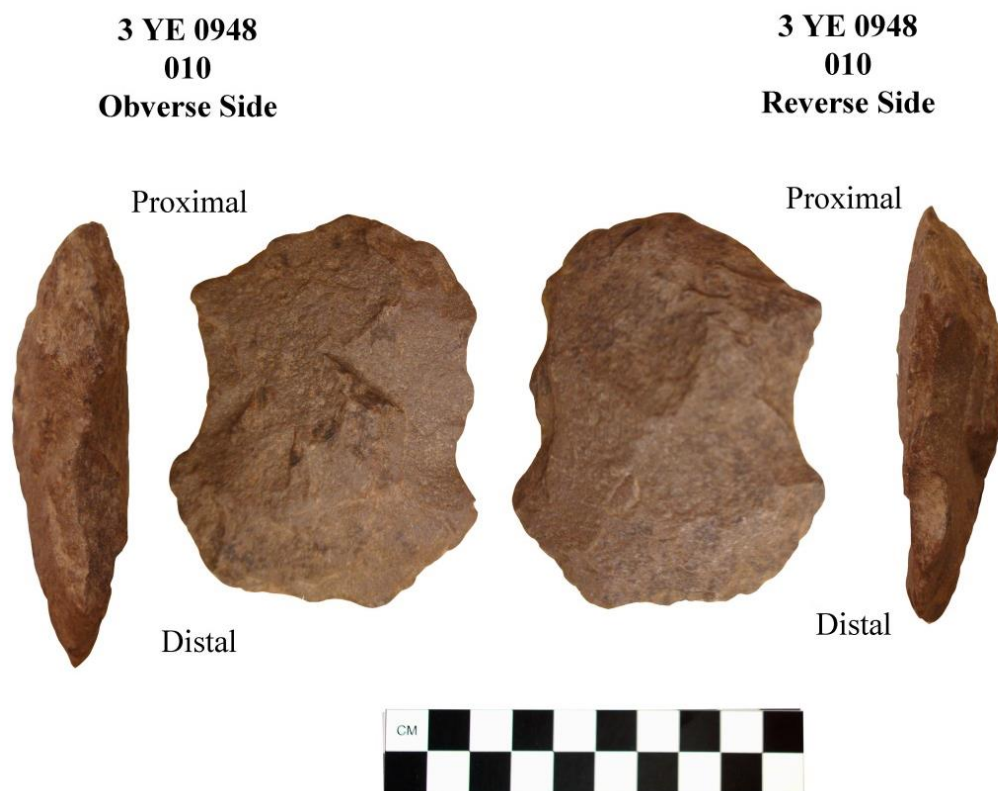


Figure 173. The obverse and reverse side of Artifact 010.

3 YE 0948
010
Reverse Side



Figure 174. Casting locations on the reverse side of Artifact 010.

3 YE 0948
010
Reverse Side

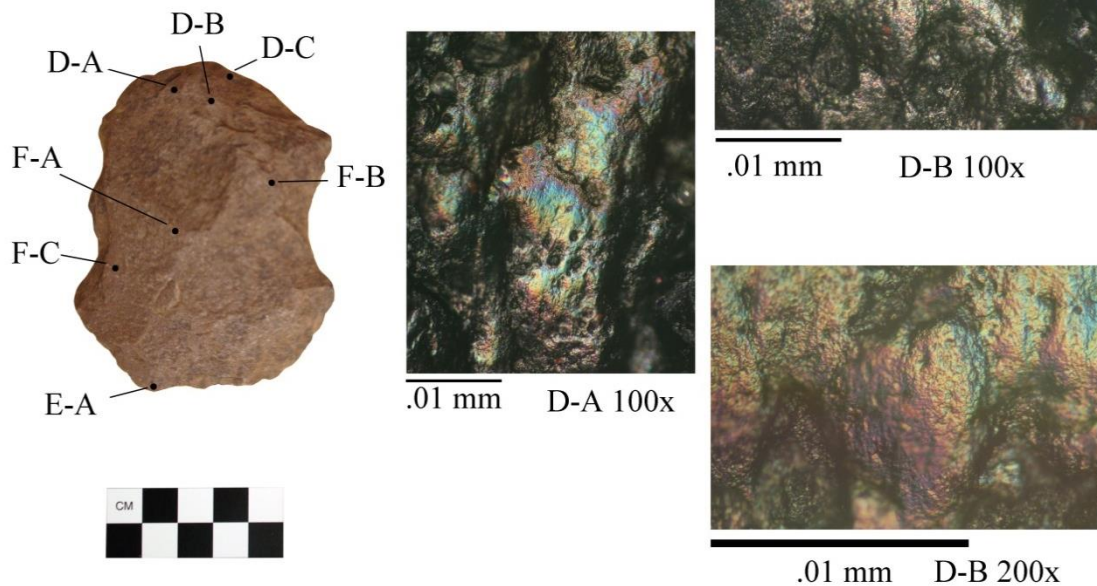


Figure 175. Bit edge wear on the reverse side of Artifact 010, Locations D-A and D-B, showing microplating and light abrasive wear.

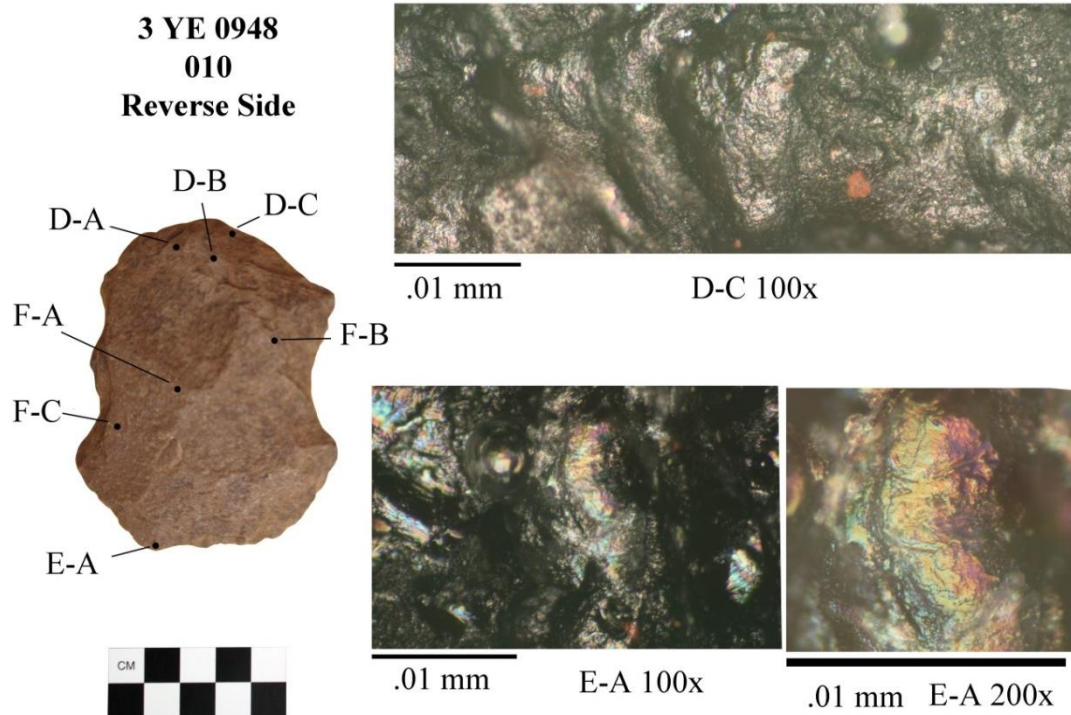


Figure 176. Bit edge wear on the reverse side of Artifact 010, Locations, D-C and E-A, showing heavy microplating with light abrasive wear.

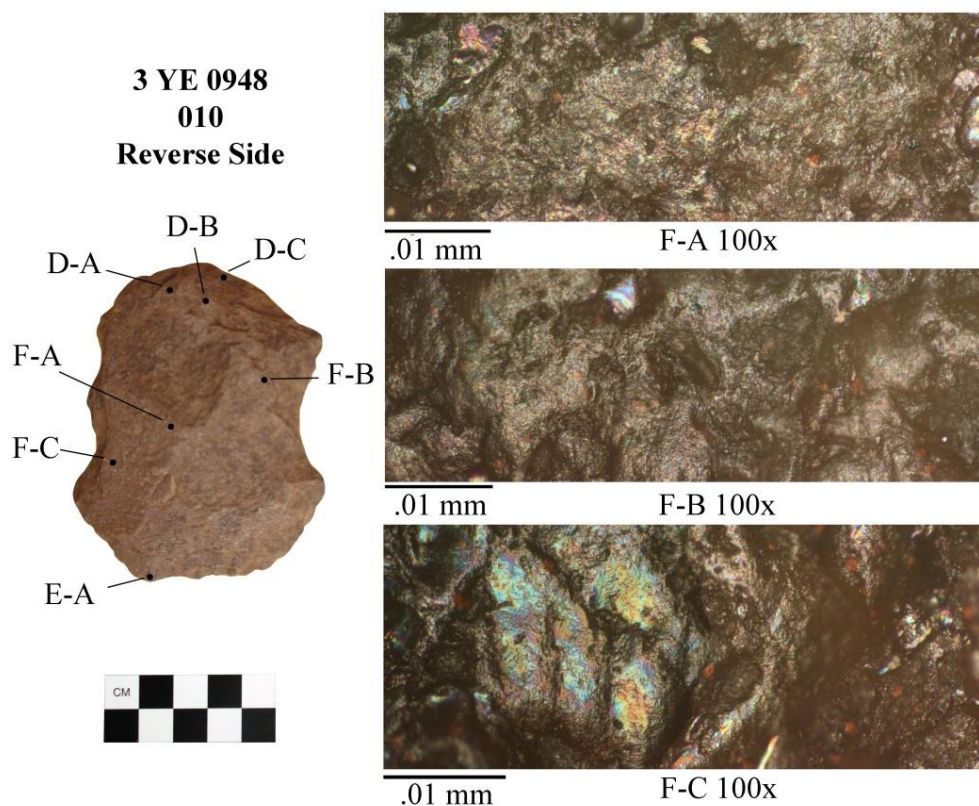


Figure 177. Hafting wear on the reverse side of Artifact 010, showing heavy directional additive microplating with light abrasive wear.

Artifact 011

Artifact 011 is a well-worn double bitted tool with all portions intact (Figure 178). It is made up of dark silicified sandstone and contains numerous step fractures. Both edges are rounded and smooth and show significant grinding and heavy polish. The hafting portions of this tool are extremely well worn and polish can be seen on the hafting edges and on the high central portions of the tool. Artifact 011 weighs 188.9 grams, with a length of 100.4 mm, width of 69.2 mm and a thickness of 24.3 mm.

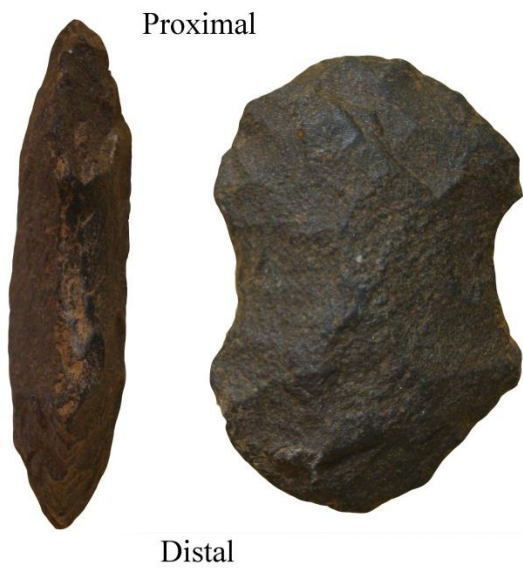
Casting

Three casts were taken from Artifact 011, a proximal (A), distal (B) and haft (C), all from the obverse side of the tool. Cast # 29, the obverse proximal was taken from Batch 9 and measured 33.16 mm in length and 34.36 mm in width. The obverse distal, Cast #30, was produced from Batch 9 and measures 26.0 mm in length and 44.66 mm in width. Cast #31, the obverse haft, was taken from Batch 7 and measures 58.03 mm in length and 29.98 mm in width (Figure 179).

Use-wear

Bit edge wear consists of heavy microplating wear which is directional in nature and has additional abrasion on top. Hafting wear also consist of heavy additive wear with locations of few small striations (Figures 180-184).

**3 YE 0948
011
Obverse Side**



**3 YE 0948
011
Reverse Side**

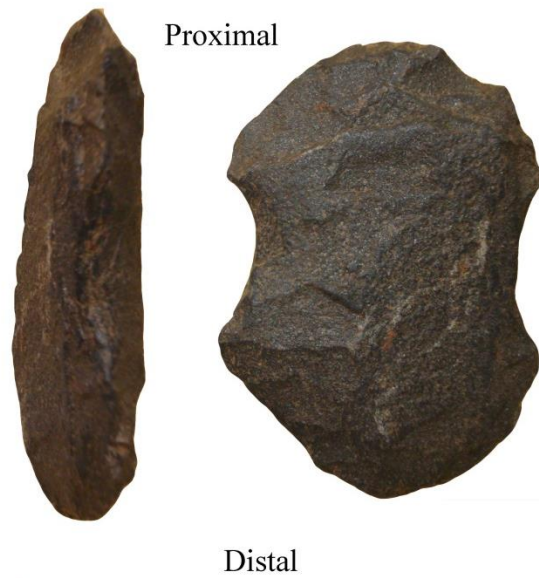


Figure 178. The obverse and reverse sides of Artifact 011.

**3 YE 0948
011
Obverse Side**



Figure 179. Casting locations on the obverse side of Artifact 011.

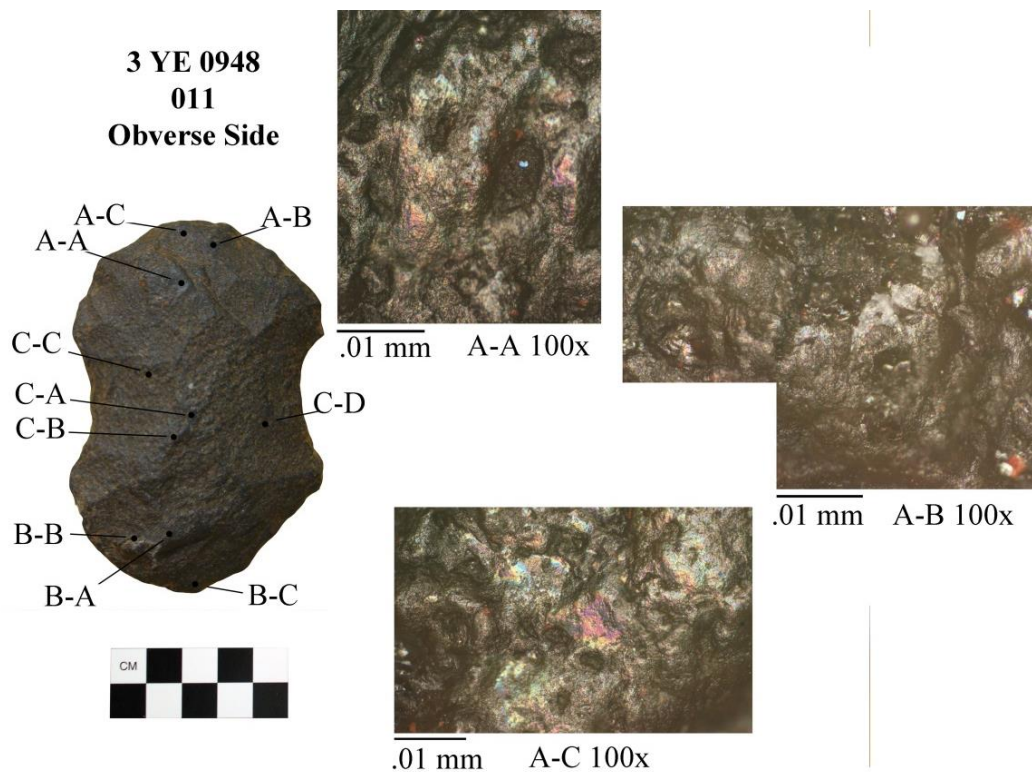


Figure 180. Bit edge wear on the obverse side of Artifact 011, Locations A-A, A-B and A-C, showing heavy directional microplating with light abrasive wear.

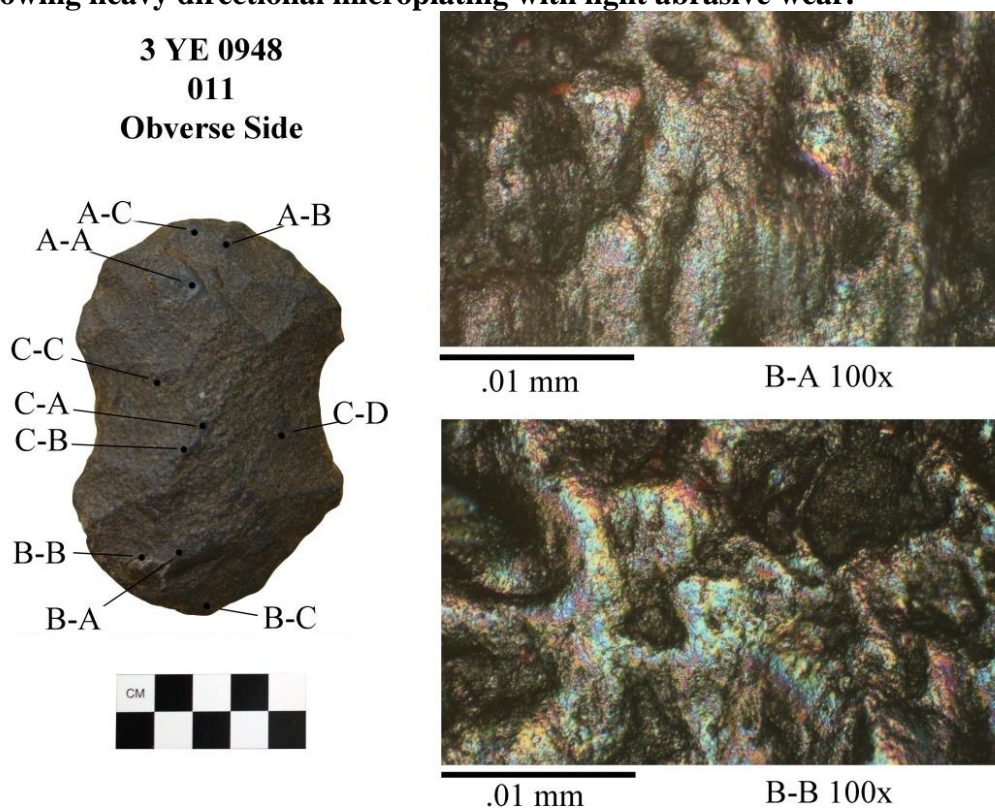


Figure 181. Bit edge wear on the obverse side of Artifact 011, Locations B-A and B-B, showing heavy directional microplating with light abrasive wear.

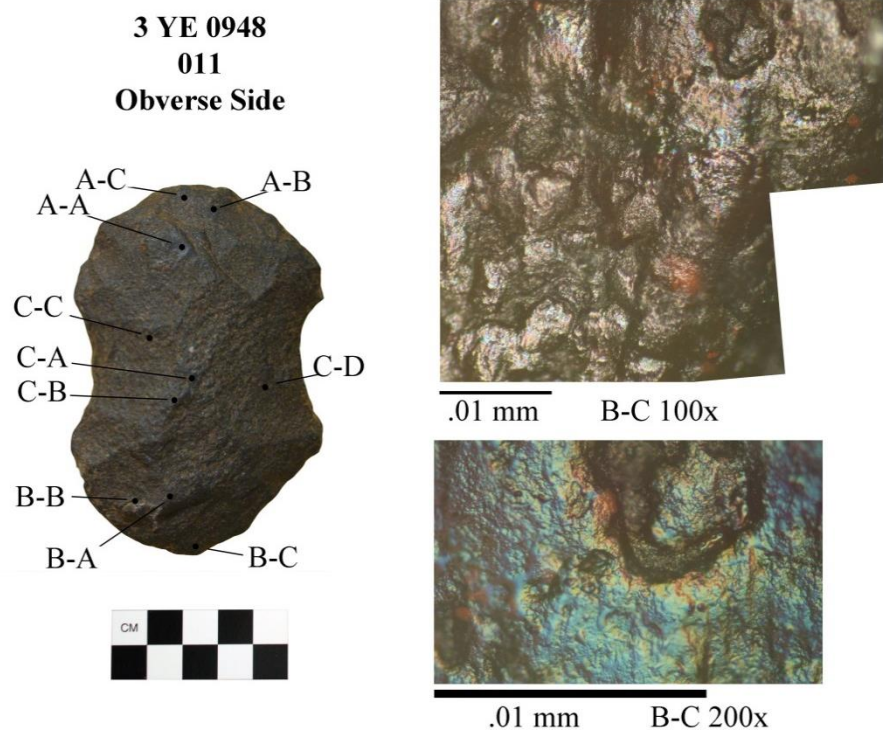


Figure 182. Bit edge wear on the obverse side of Artifact 011, Location B-C, showing heavy directional microplating with light abrasive wear.

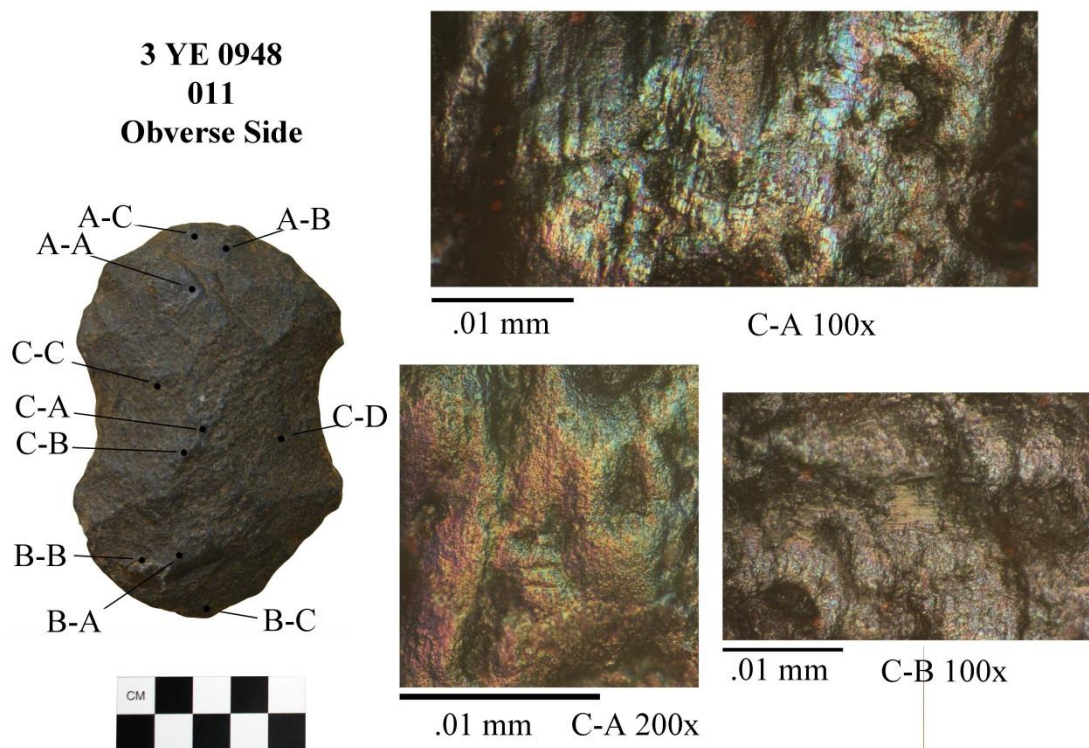


Figure 183. Hafting wear on the obverse side of Artifact 011, Locations C-A and C-B, showing heavy microplating and light directional striation wear.

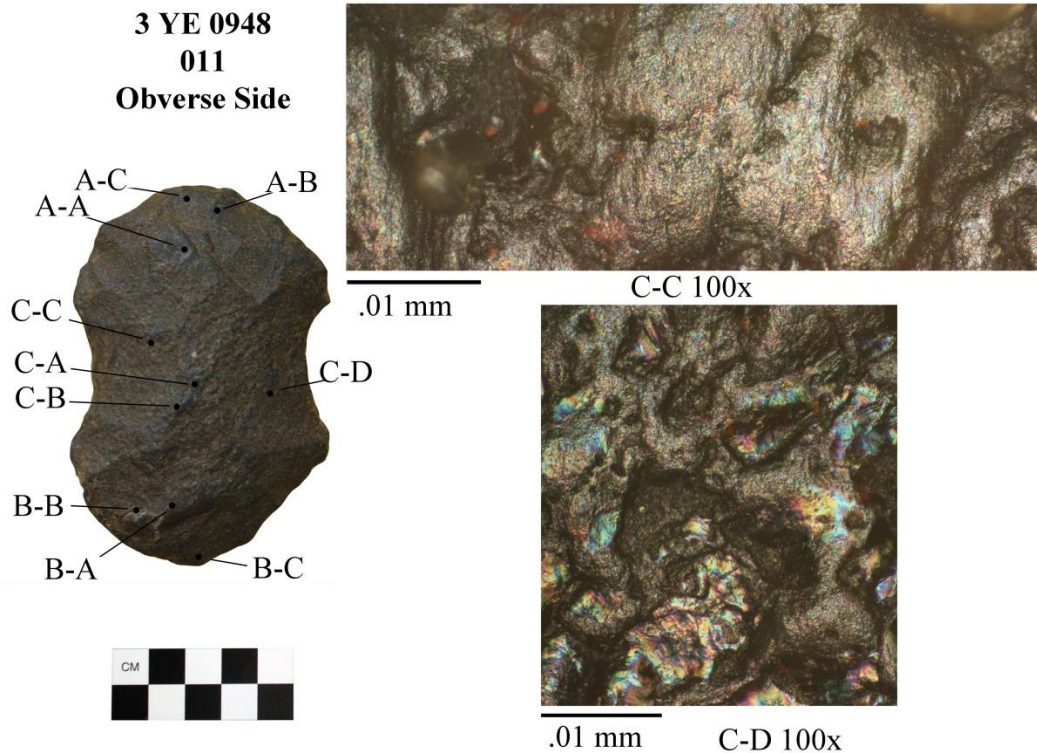


Figure 184. Hafting wear on the obverse side of Artifact 011, Locations C-A and C-B, showing heavy microplating and light directional striation wear.

Artifact 012

Artifact 012 is a complete double bitted tool made of silicified sandstone (Figure 185). Artifact 012 has triangular bits and the edges show little to no evidence of edge smoothing or grinding. Potential hafting polish on one side of the tool, but hafting notches do not show evidence of smoothing. Artifact 012 weighs 157.5 grams with a length of 101.2 mm, a maximum width of 63.3 mm and a thickness of 23.8 mm.

Casting

A total of three casts were taken from Artifact 12, a proximal (A), distal (B) and haft (C), all from the obverse side. Cast #32, the obverse proximal was taken from Batch 3, with a length of 32.26 mm and width of 34.96 mm. Cast #33 was also taken from Batch 3. The length was

33.22 mm by 34.91 mm for width. Cast #34, the obverse haft, was taken from Batch 6 and measures 45 mm in length and 34.3 mm in width (Figure 186).

Use-wear

Bit wear on Artifact 012 consists of large portions of microplating with a few locations of multi-directional striations which are partially filled in. Hafting wear consists of plane-like portions of microplating which have slight smoothing of the surface (Figures 187-191).



Figure 185. The obverse and reverse sides of Artifact 012.

**3 YE 0948
012
Obverse Side**



Figure 186. Casting locations on the obverse side of Artifact 012.

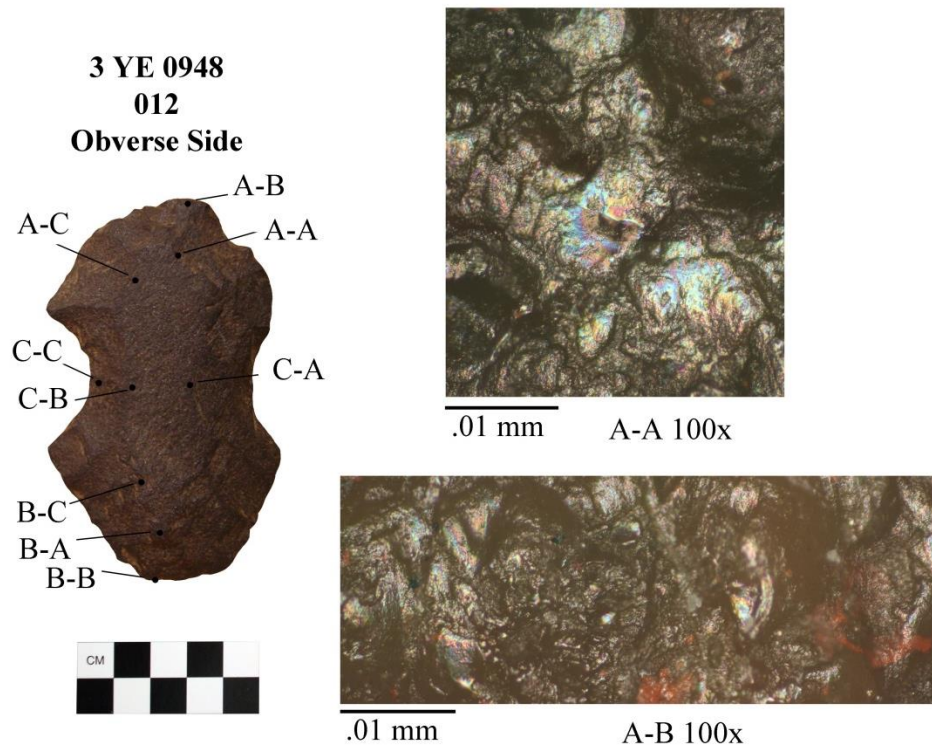


Figure 187. Bit edge wear on the obverse side of Artifact 012, Locations A-A and A-B, showing microplating and light abrasive wear.

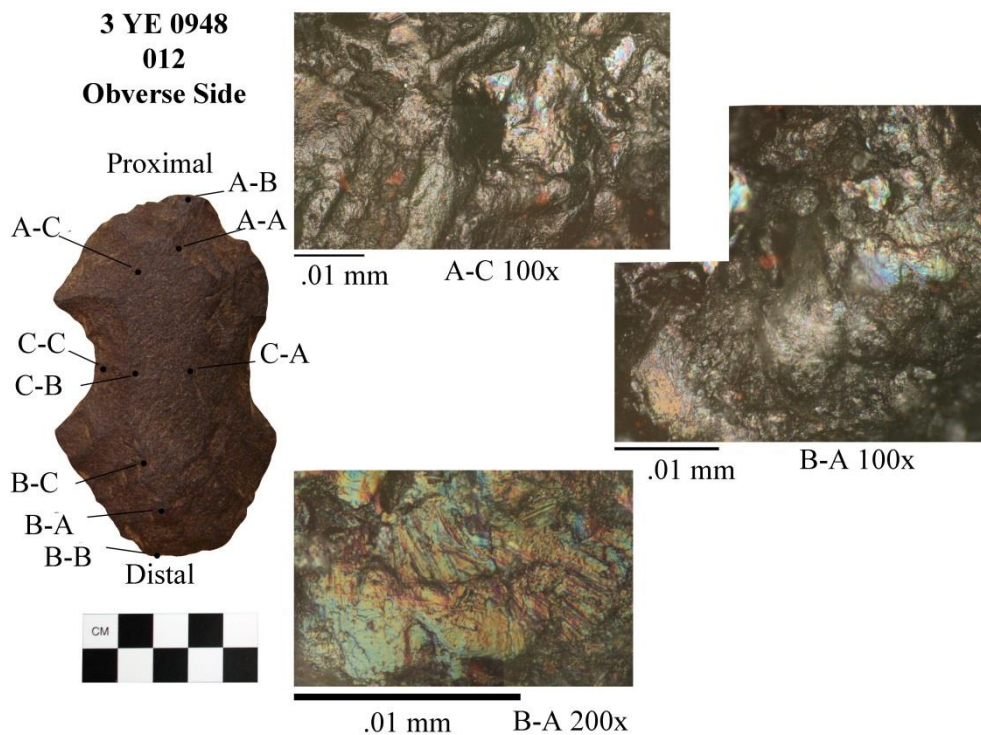


Figure 188. Bit edge wear on the obverse side of Artifact 012, Locations A-C and B-A, showing heavy microplating and light abrasive wear with B-A showing additional multi-directional striations.

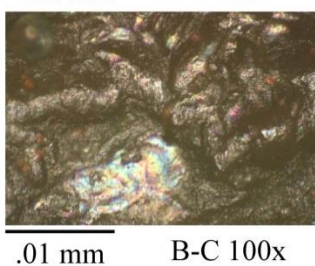
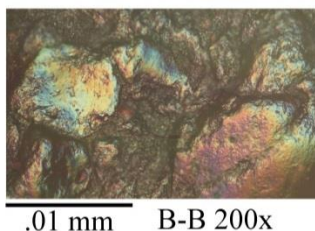
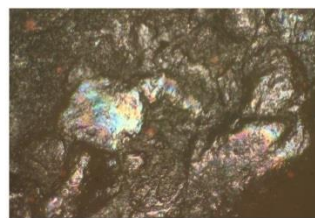
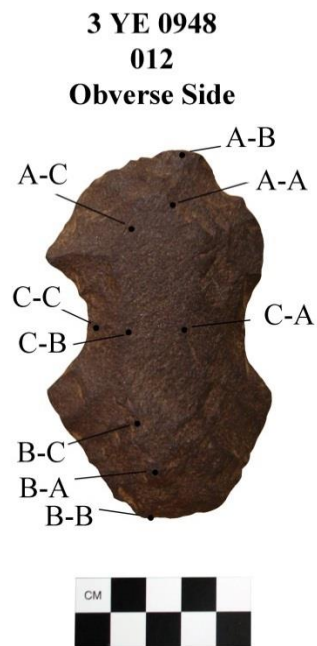


Figure 189. Bit edge wear on the obverse side of Artifact 012, Locations B-B and B-C, showing heavy microplating and light abrasive wear.

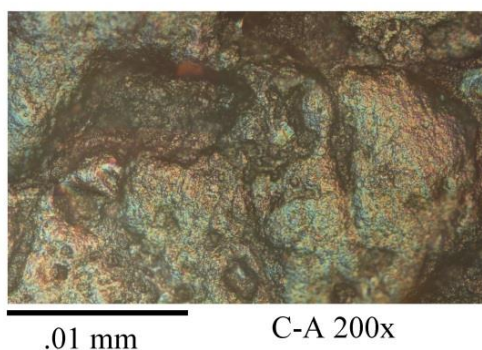
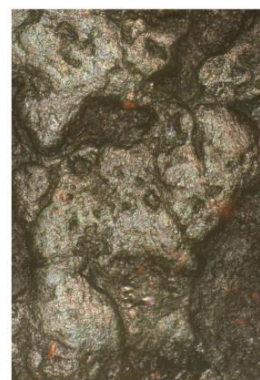
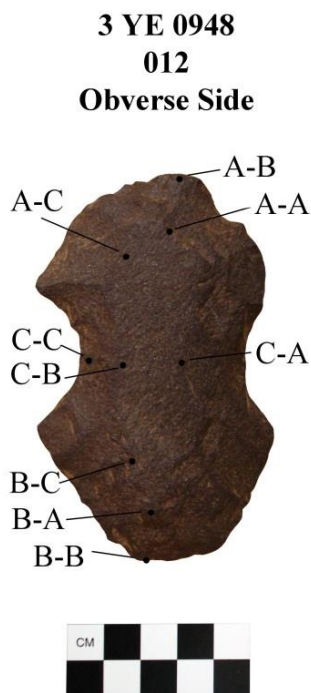


Figure 190. Hafting wear on the obverse side of Artifact 012, Location C-A, showing heavy microplating wear with light abrasion.

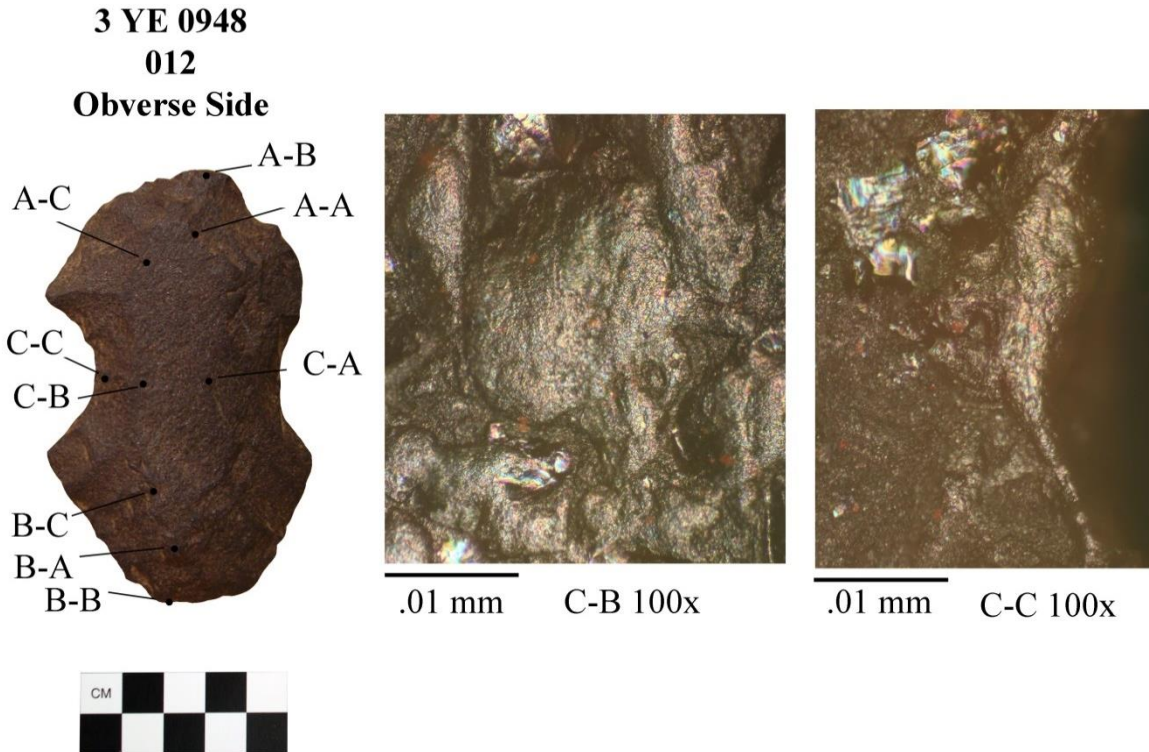


Figure 191. Hafting wear on the obverse side of Artifact 012, Location C-A, showing heavy microplating wear with light abrasion.

Artifact 013

Artifact 013 is a roughly shape tool in the double bitted form (Figure 192). The artifact is made of sandstone. It is very fragmented and appears to be in the earliest stages of production. The hafting portion has been completed and the proximal edge has rounding and smoothing of the edge. The distal edge is heavily fragmented and may have been the cause for rejection of the tool. This tool belongs to the category of potential toys or practice pieces. Artifact 013 weights 184.0 grams, with a length of 109.2 mm, width of 74.8 mm and a maximum thickness of 18.6 mm.

Casting

Two casts were taken from Artifact 013, a proximal (D) and haft (F), both from the reverse side. Cast #35, the reverse proximal was taken from Batch 3, with the length being 26.99

mm and width being 45.82 mm. Cast #36, the reverse haft, was taken from Batch 8 and measures 55.06 mm in length and 25.88 mm in width (Figure 193).

Use-wear

Bit edge wear on this tool has light abrasion with few locations where microplating can be seen. Hafting wear is very similar with light abrasion with some microplating present (Figures 194- 197).



Figure 192. The obverse and reverse side of Artifact 013.

**3YE 0948
013
Reverse Side**



Figure 193. Casting locations on the reverse side of Artifact 013.

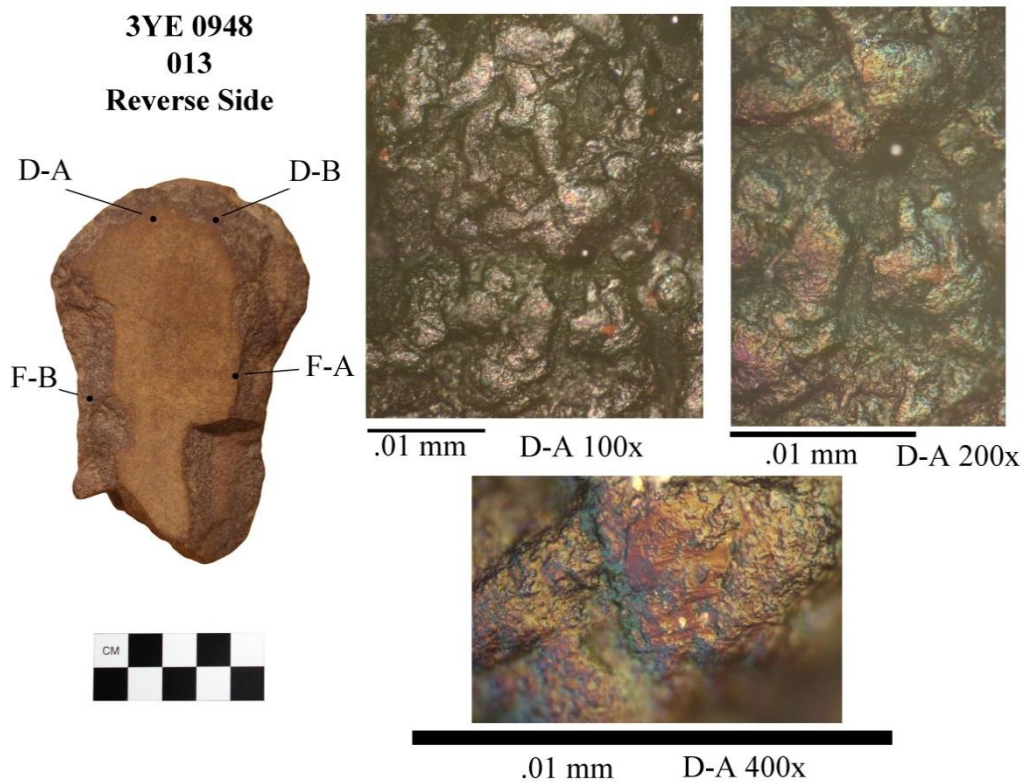


Figure 194. Bit edge wear on the reverse side of Artifact 013, Location D-A, showing directional additive wear with light filled in striation wear.

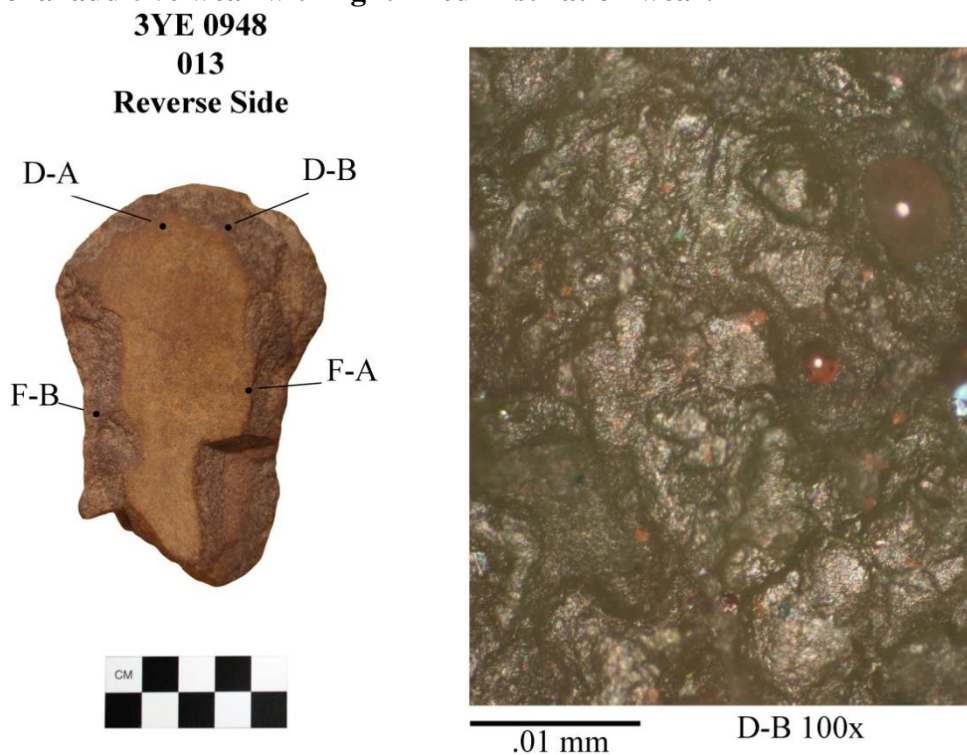


Figure 195. Bit edge wear on the reverse side of Artifact 013, Location D-B, showing generalized abrasion with the beginnings of additive microplating wear.

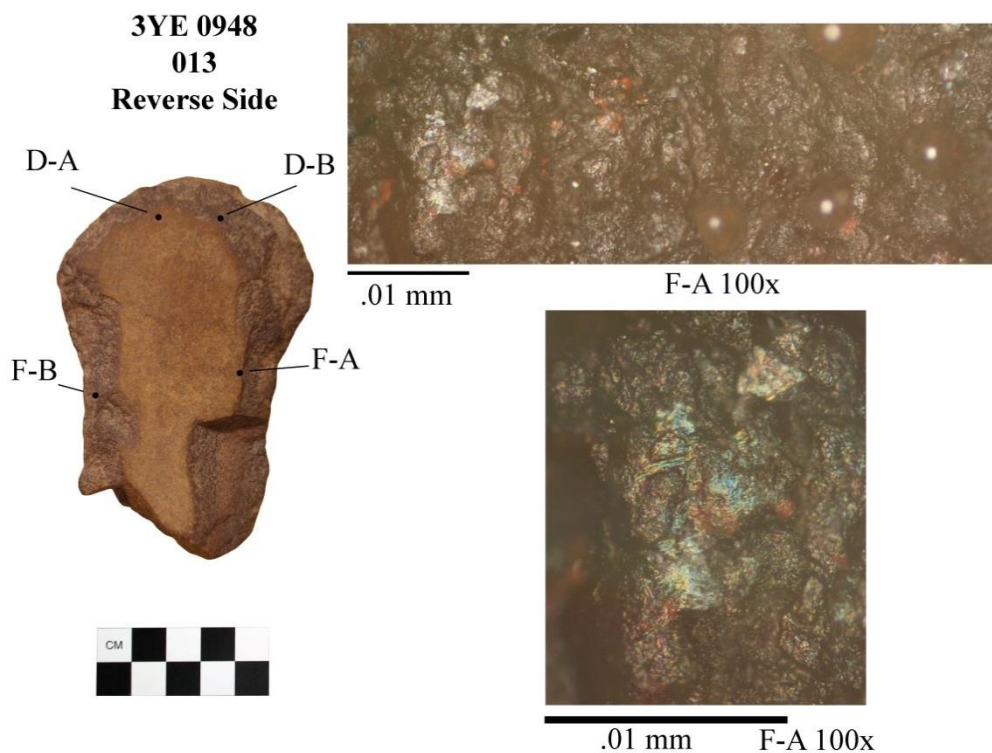


Figure 196. Hafting wear on the reverse side of Artifact 013, Location F-A, showing generalized abrasion and microplating wear.



Figure 197. Hafting wear on the reverse side of Artifact 013, Location F-B, showing generalized abrasion and the beginnings of additive wear.

Artifact 014

Artifact 014 is damaged double bitted tool made of sandstone, where only half of the tool remains (Figure 198). This tool belongs to the practice piece toy category. Cortex appears on both sides, suggesting this tool was created out of a flat shaped rock. The proximal edge and a portion of the hafting area are intact. Tool is in the secondary stage of production with the hafting portion clearly defined and shows some evidence of wear and smoothing. Light polish can be seen in the hafting portion. The edge has some smoothing, but no evidence of heavy grinding. Artifact 014 has a dense weight of 226.8 grams with a length of 80.6 mm, a maximum width of 93.9 mm and a thickness of 24.6 mm.

Casting

A total of two casts were taken from Artifact 014, a proximal (D) and a haft (F), both from the reverse side. Cast #37, the reverse proximal was taken from Batch 3. The length measures 27.82 mm and the width 63.71 mm. Cast #38, the reverse haft, was taken from Batch 6 and measures 60.71 mm in length and 23.62 mm in width (Figure 199).

Use-wear

Bit edge wear consists of microplating with directional partially filled in striations. Hafting wear has large coarse microplating with no obvious additional abrasion (Figures 200 - 203).



Figure 198. The obverse and reverse sides of Artifact 014.

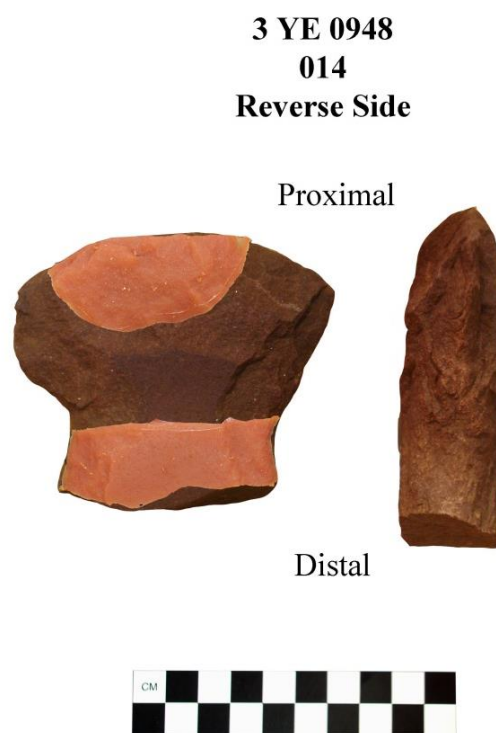


Figure 199. Casting locations on the reverse side of Artifact 014.

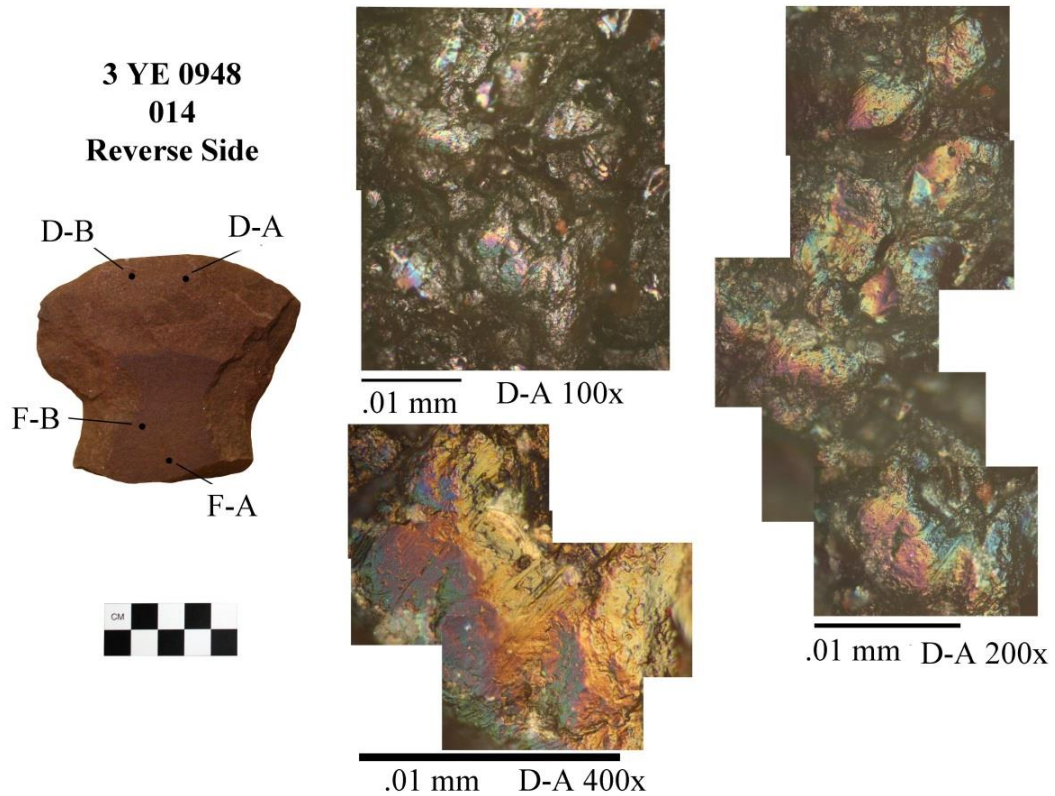


Figure 200. Bit edge wear on the reverse side of Artifact 014, Location D-A, showing microplating wear with few light striations which are in the process of becoming filled in.

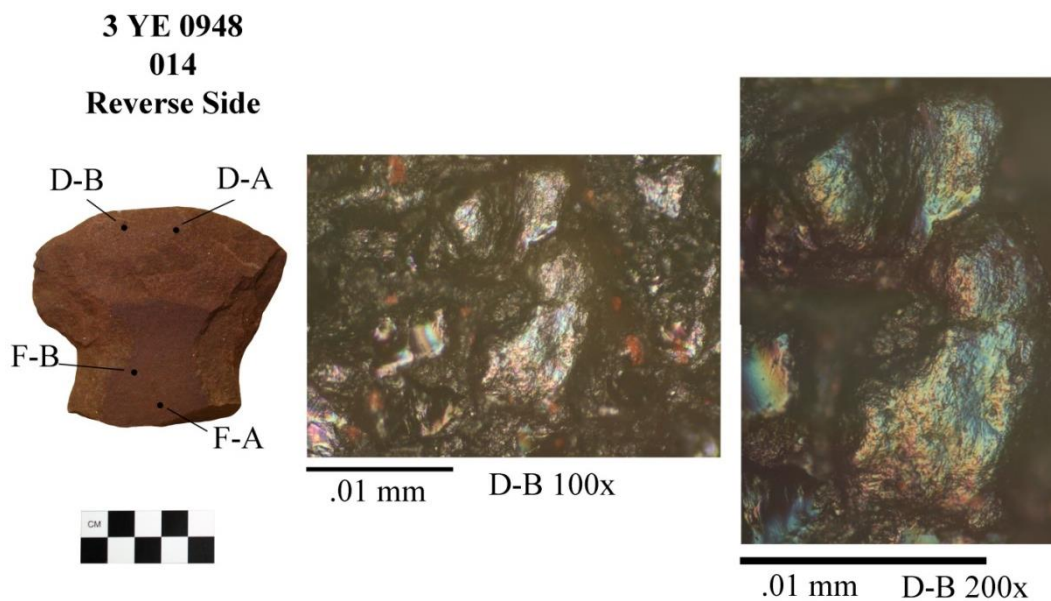


Figure 201. Bit edge wear on the reverse side of Artifact 014, Location D-B, showing microplating wear.

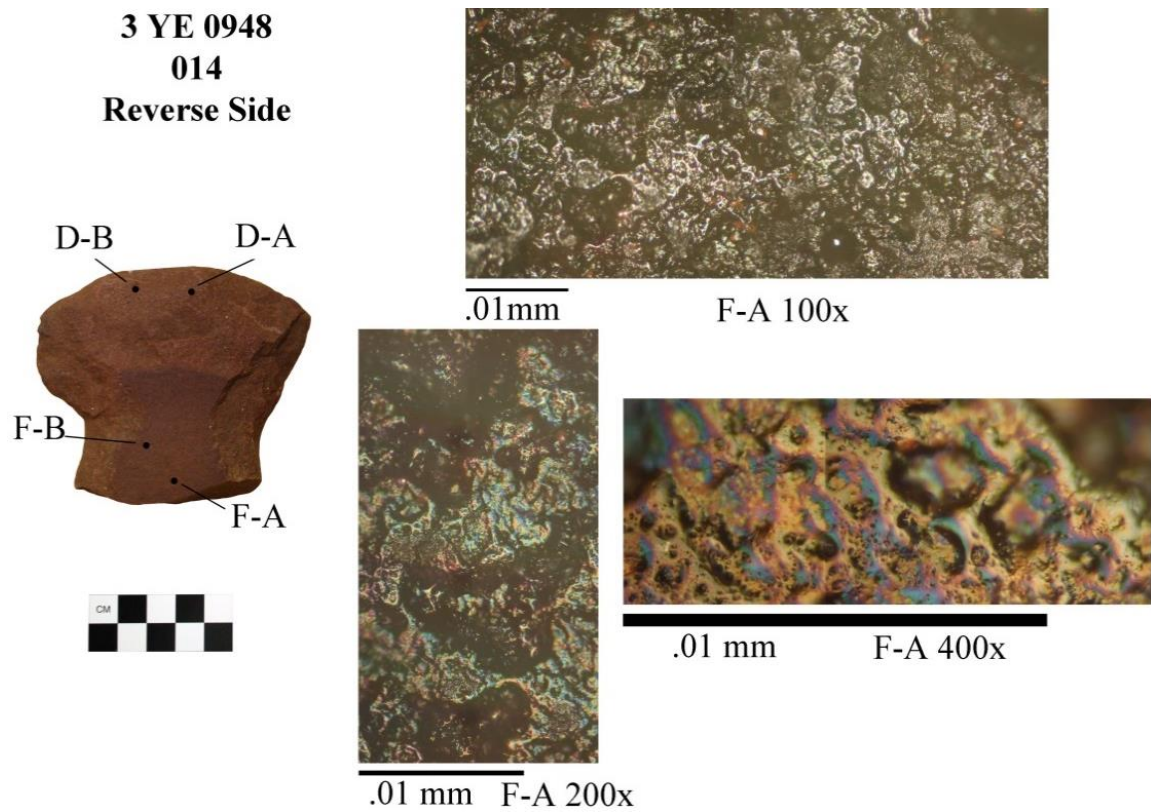


Figure 202. Cast error on the reverse side of Artifact 014, Location F-A showing oil on the cast.

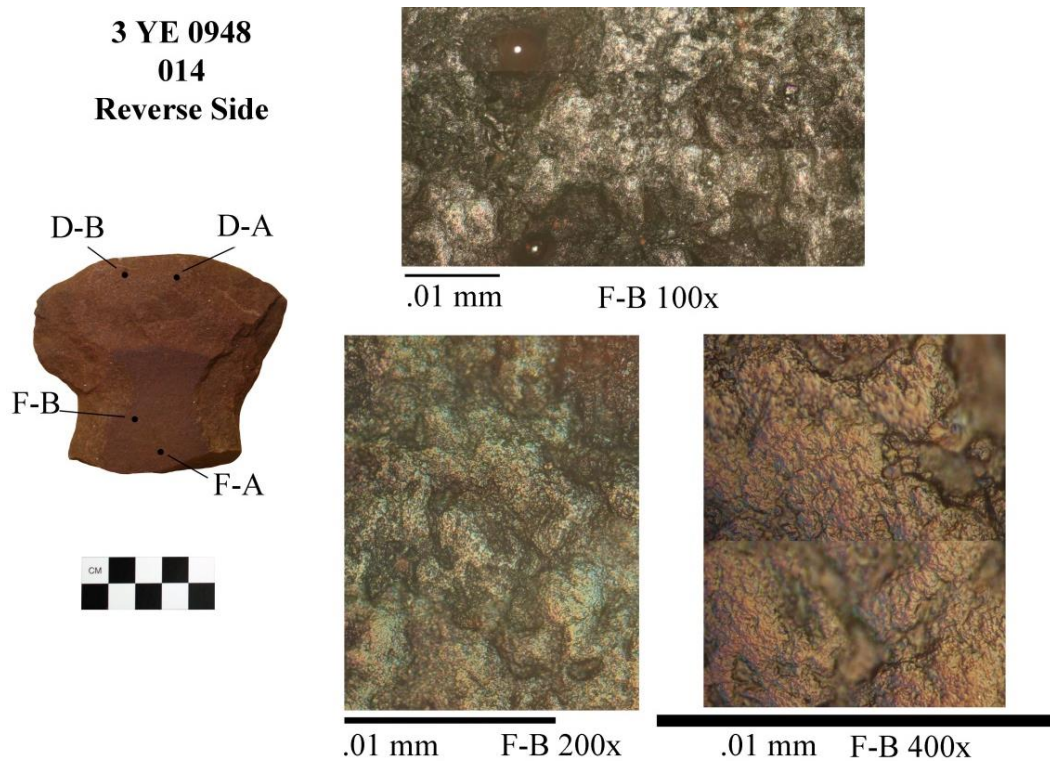


Figure 203. Hafting wear on the reverse side of Artifact 014, Location F-B, showing heavy directional microplating wear.

Artifact 015

Artifact 015 is a damaged bit portion of a double bitted tool (Figure 204). This tool shows lots of wear, with polish easily being seen in multiple locations on the tool. The tool is made of silicified sandstone with an inclusion of darker stone material, located near the proximal edge. The bending fracture damage suggests this tool was damaged during use. Artifact 015 weighs 169.5 grams, with a length of 77.4 mm, a width of 76.0 mm and a maximum thickness of 25.3 mm.

Casting

Only one cast was retrieved from Artifact 015, a reverse proximal (D). This cast is #39 and was taken from Batch 5, with the length of 36.04 mm and the width of 48.83 mm (Figure 205).

Use-wear

Wear on the bit edge shows heavy directional microplating wear which has been abraded smooth and has some small light striations present (Figure 206).



Figure 204. The obverse and reverse side of Artifact 015.

**3 YE 0948
015
Reverse Side**



Figure 205. Casting location on the reverse side of Artifact 015.

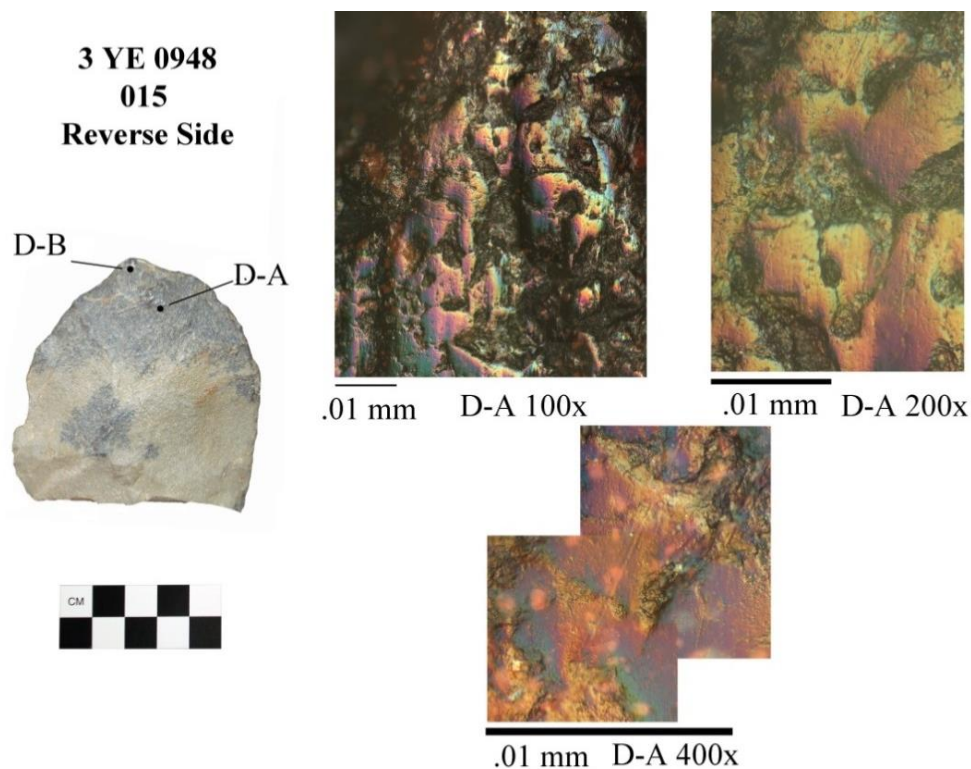


Figure 206. Bit edge wear on the reverse side of Artifact 015, Location D-A, showing heavy directional microplating and a few light striations.

Artifact 016

Artifact 016 is a dense half of a double bitted tool, made of low quality silicified sandstone (Figure 207). The edge is rounded, but very thick. There is some grinding, but the edge is not well defined. The hafting edge has some grinding, while the hafting portion does not show evidence of polish. Artifact 016 is a heavy 270.6 grams with a length of 83.8 mm, width of 71.0 mm and thickness of 31.8 mm.

Casting

Only one cast was taken from Artifact 16, an obverse proximal (A), from Batch 5. This is Cast #40 and measures 35.66 mm in length and 48.16 mm in width (Figure 208).

Use-wear

Bit edge wear shows large portions of microplating wear with locations of numerous multi-directional striations (Figures 209-211).



Figure 207. The obverse and reverse sides of Artifact 016.

3 YE 0948
016
Obverse Side
Proximal



Distal



Figure 208. Casting location on the obverse side of Artifact 016.

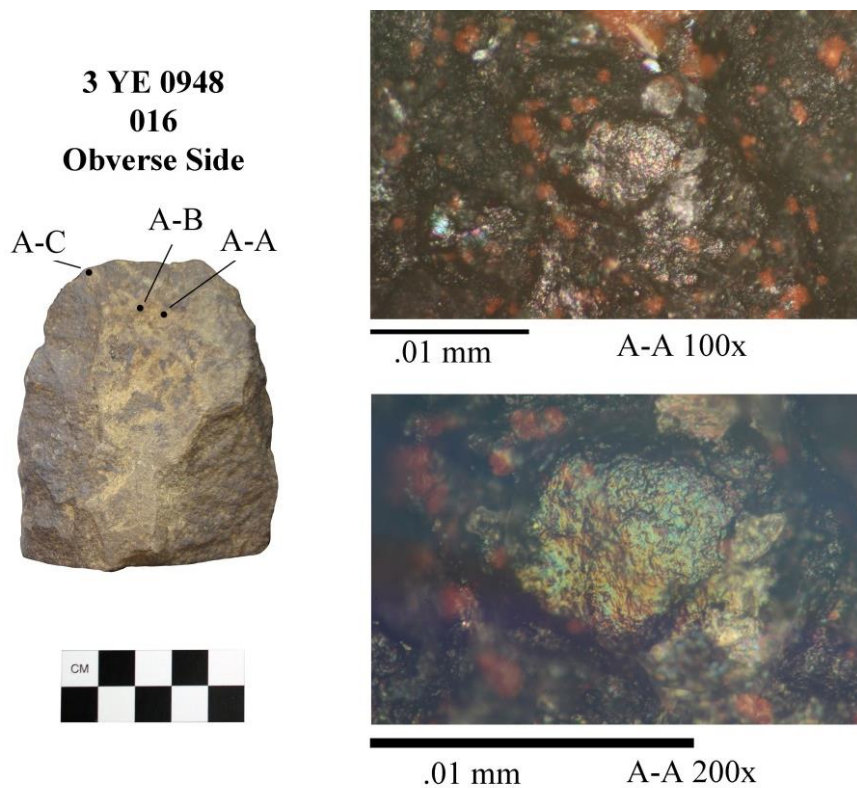


Figure 209. Bit edge wear on the obverse side of Artifact 016, Location A-A, showing microplating and light abrasive wear.

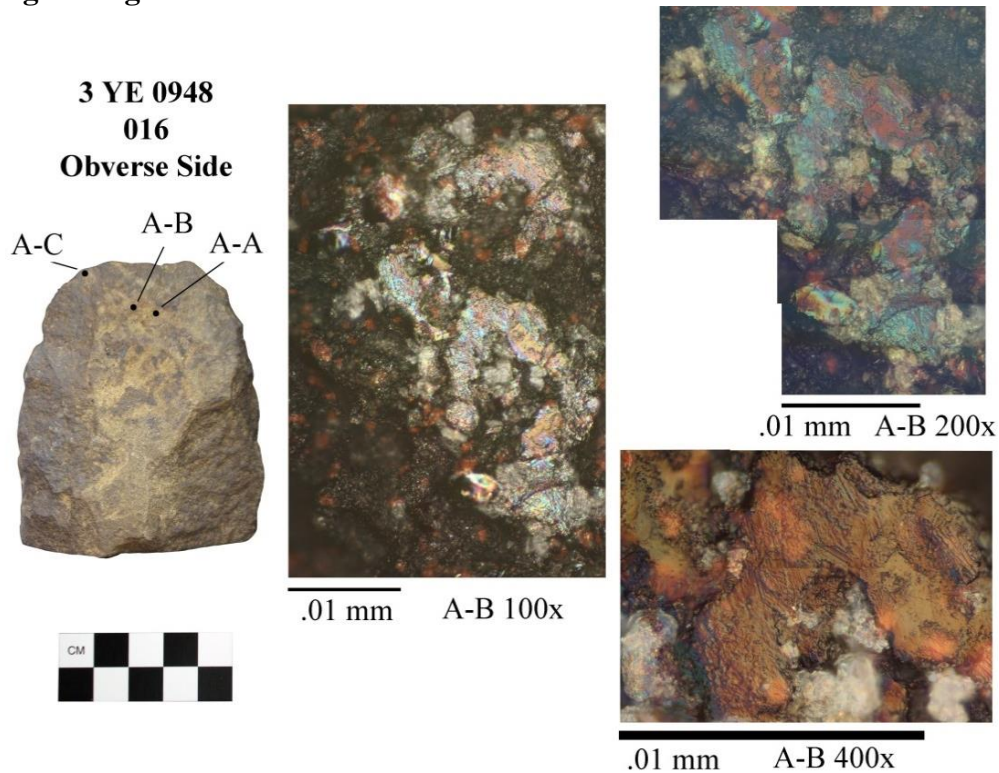


Figure 210. Bit edge wear on the obverse side of Artifact 016, Location A-B, showing heavy microplating and multi-directional striations.

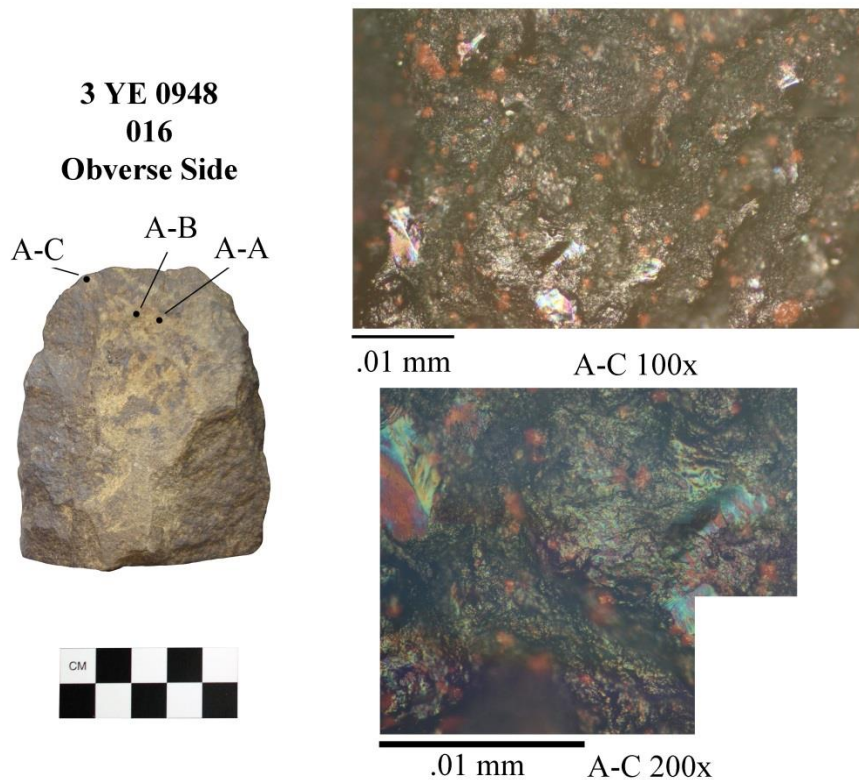


Figure 211. Bit edge wear on the obverse side of Artifact 016, Location A-C, showing generalized abrasion and the beginnings of microplating.

Artifact 017

Artifact 017 is a portion of a tool belonging to the practice piece or toy category (Figure 212). This tool is made of poor quality sandstone and looks as though it was simply shaped into a tool like shape. No obvious wear could be seen macroscopically. The artifact has hematite covering the reverse side and was potentially used as a platform for the grinding of the element. The shape of the tool was then modified by a novice to approximate the shape of the tool form. Artifact 017 weighs 181.8 grams, with a length of 108.7 mm, width of 84.1 mm and maximum thickness of 17.6 mm.

Casting

Two casts were taken from Artifact 017, a proximal (D) and a haft (F), both from the reverse side. Cast #41, the reverse proximal, was taken from Batch 3, with a length of 26.44 mm

and width of 46.03 mm. Cast # 42, the reverse haft, was created from Batch 10 and measures 56.18 mm in length and 24.16 mm in width (Figure 213).

Use-wear

Bit edge wear shows generalized abrasion throughout the tool, but also locations of large microplating wear. These areas also contain multi-directional striations, many of which are overlapping or partially filled in. The hafting area, or lower portion of the tools which remains intact, showing microplating wear with few light striations and a portion of the tool with a large directional scrape (Figures 214- 219).



Figure 212. The obverse and reverse sides of Artifact 017.

3 YE 0948
017
Reverse Side

Proximal



Distal



Figure 213. Casting locations on the reverse side of Artifact 017.

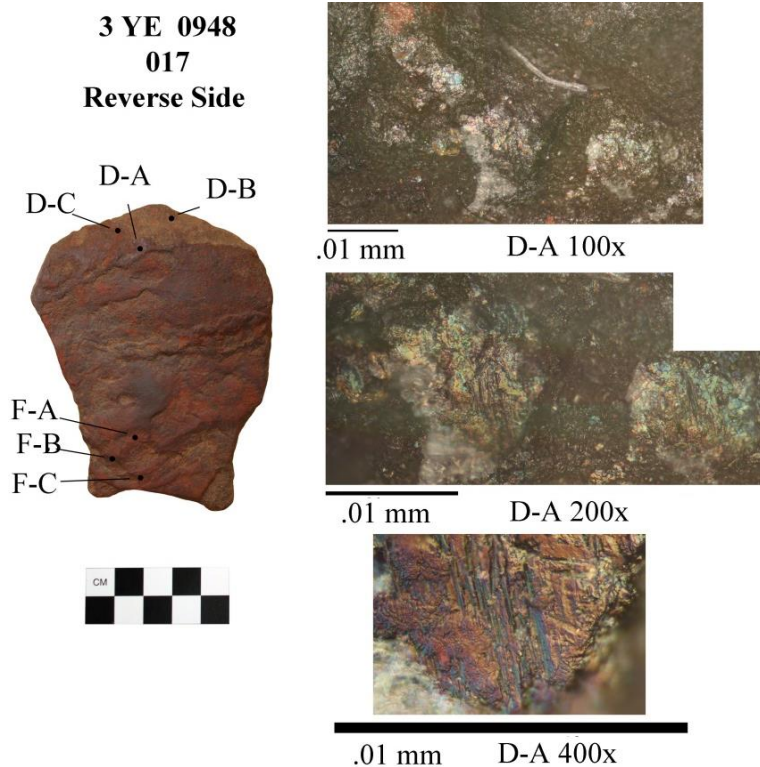


Figure 214. Bit edge wear on the reverse side of Artifact 017, Location D-A, showing microplating and multi-directional striations.

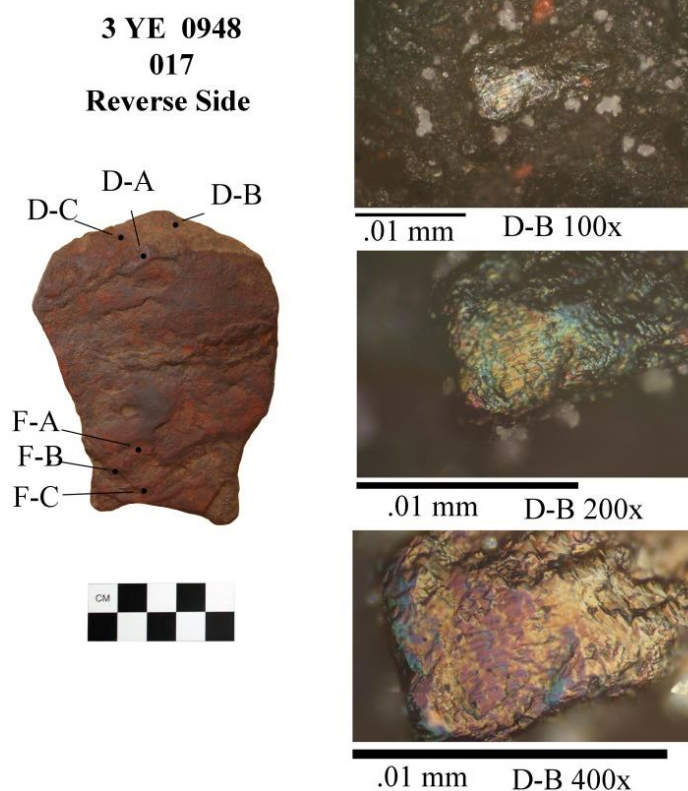


Figure 215. Bit edge wear on the reverse side of Artifact 017, Location D-B, showing microplating wear.

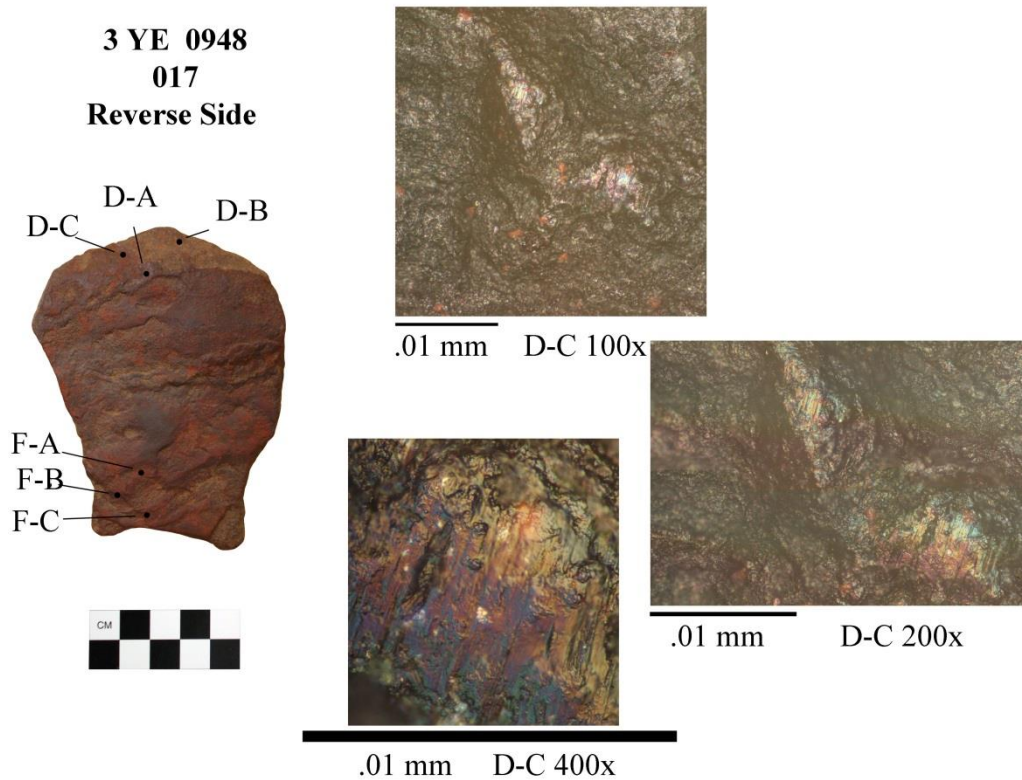


Figure 216. Bit edge wear on the reverse side of Artifact 017, Location D-C, showing microplating and light striation wear.

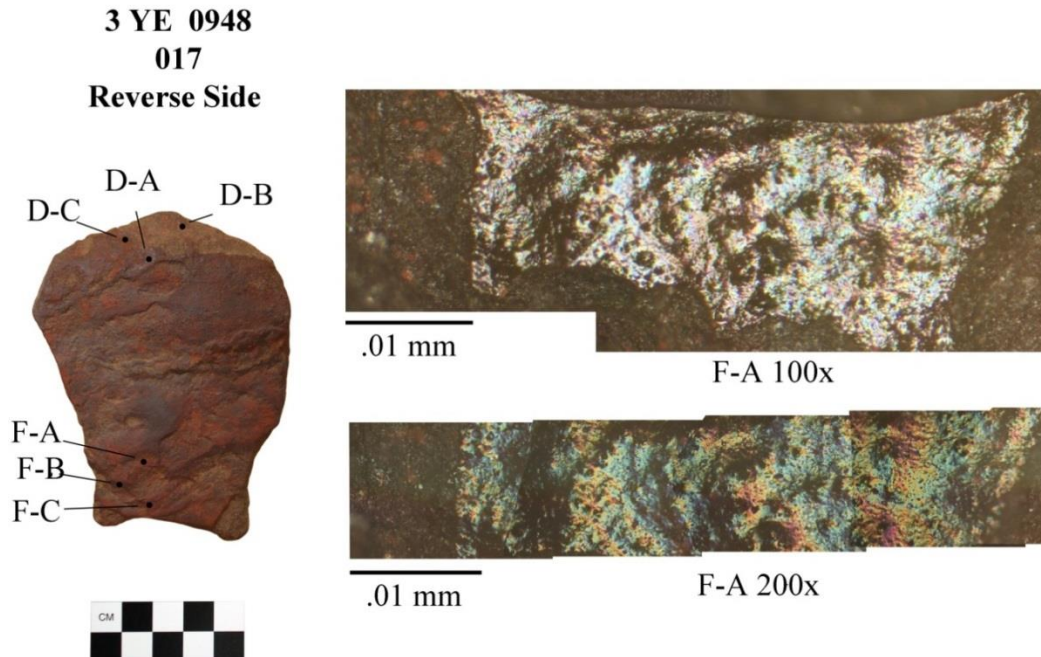


Figure 217. Casting error on the reverse side of Artifact 017, showing oil or grease on Location F-A.

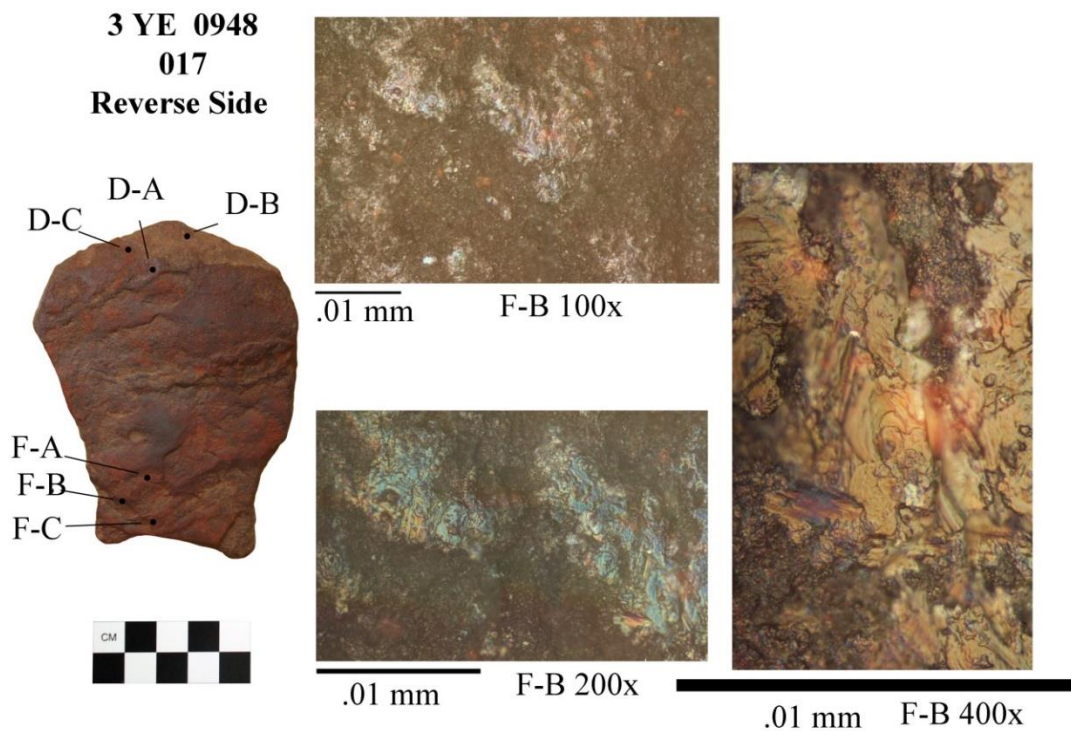


Figure 218. Hafting wear on the reverse side of Artifact 017, Location F-B, showing heavy microplating wear with few light striations.

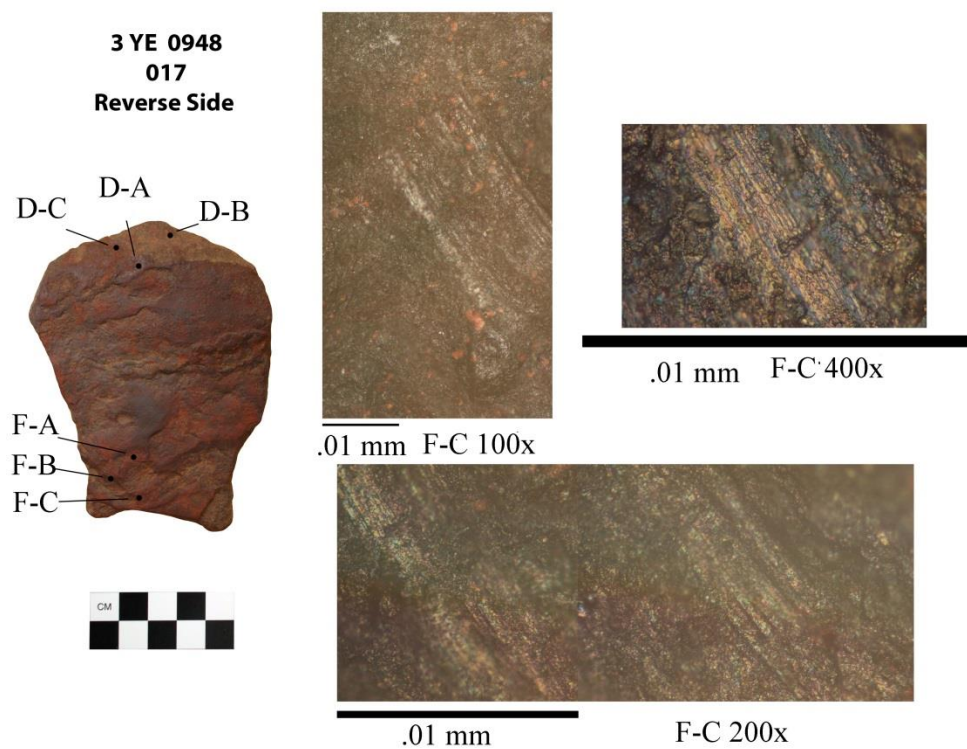


Figure 219. Hafting wear on the reverse side of Artifact 017, Location F-C, showing directional scraping wear.

Artifact 018

Artifact 018 is a roughly hewed possible tool made of poor quality sandstone (Figure 220). It is vaguely in the shape of single bitted tool. There is a large step fracture on the reverse side and the proximal side is rounded. Artifact 018 is part of the practice piece or toy category and is looks as though it was crudely shaped into the tool form. The texture of stone suggests that this may have been a natural cobble which was worked into a tool. Two plow scars can be seen on the face. The edge damage which occurred is possibly from plow damage to the tool. The proximal edge of the tool is rounded and potentially was use for either grinding or battering. Artifact 018 weighs 200.4 grams with a length of 101.2 mm, a maximum width of 93.2 mm and a thickness of 19.4 mm.

Casting

Only one cast was taken of Artifact 018, an obverse proximal (A) from Batch 2. This is Cast # 43, measuring 32.68 mm in length and 61.78 mm in width (Figure 221).

Use-wear

Wear seen on the bit edge is minimal with a few locations showing microplating with striations running perpendicular to the bit edge and light generalized abrasion (Figures 222-223).

3 YE 0948
018
Obverse Side
Proximal



Distal

3 YE 0948
018
Reverse Side
Proximal



Distal



Figure 220. The obverse and reverse sides of Artifact 018.

**3 YE 0948
018
Obverse Side**

Proximal



Distal



Figure 221. Casting location on the obverse side of Artifact 018.

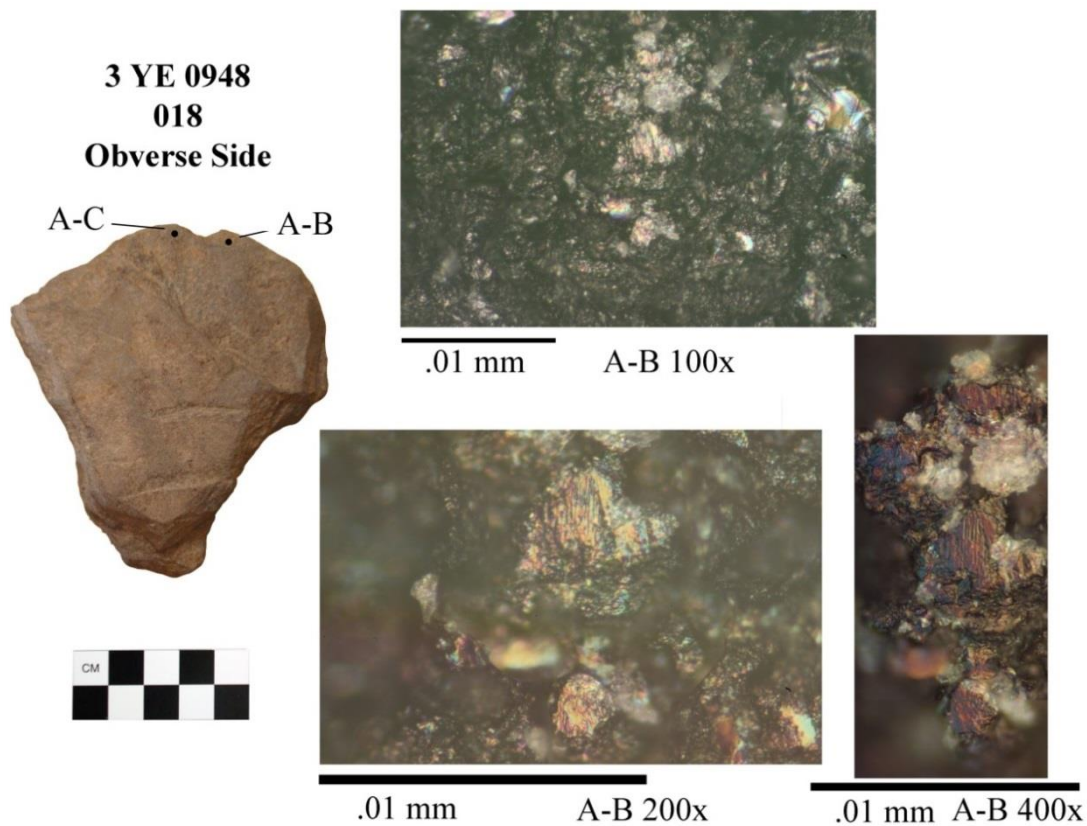


Figure 222. Bit edge wear on the obverse side of Artifact 018, Location A-B, showing light additive microplating wear with striations running perpendicular to bit edge.

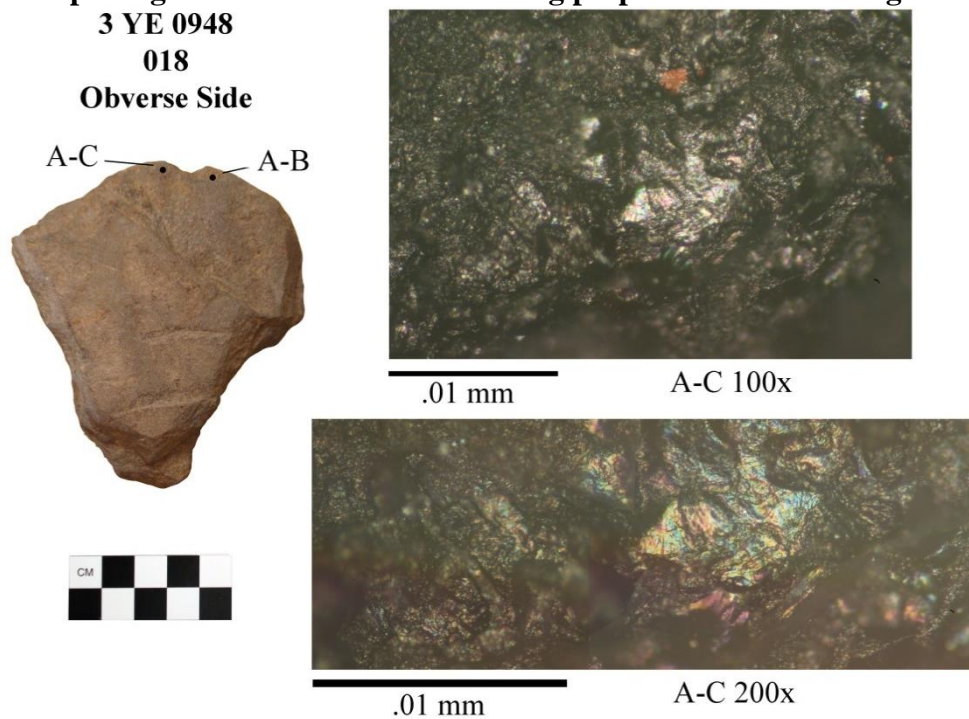


Figure 223. Bit edge wear on the obverse side of Artifact 018, Location A-C, showing light additive wear.

Artifact 019

Artifact 019 was a number given in the original collection from Mr. Darrel Smith. However, the collection did not actually contain a tool with the collection number of 19. The number was kept in the data set since Artifact 19 exists, it just did not make it to the University for analysis.

Artifact 020

Artifact 020 is a chunky double bitted tool made of sandstone (Figure 224). This tool is in the secondary stage of production, with the hafting portion clearly defined and the edges coarsely ground out. The edges of the tool are not defined, but some grinding is present. Polish wear cannot be seen in macro analysis. Both tool edges appear to be heavily battered. Artifact 020 weighs a hefty 444.2 grams, with a length of 123.3 mm, a width of 97.7 mm and maximum thickness of 34.7 mm.

Casting

Two casts were taken for Artifact 020, a proximal (A) and a haft (C), both from the obverse side. Cast #44, the obverse proximal, was taken from Batch 11 and measures 32.92 mm in length and 42.45 mm in width. Cast #45, the obverse haft, was taken from Batch 6 and measures 69.19 mm in length and 32.26 mm in width (Figure 225).

Use-wear

Wear on Artifact 020 is light with only a few places of wear. The bit edge shows microplating with multi-directional striations and generalized abrasion. Hafting wear shows light abrasion with the beginnings of microplating (Figures 226-228).

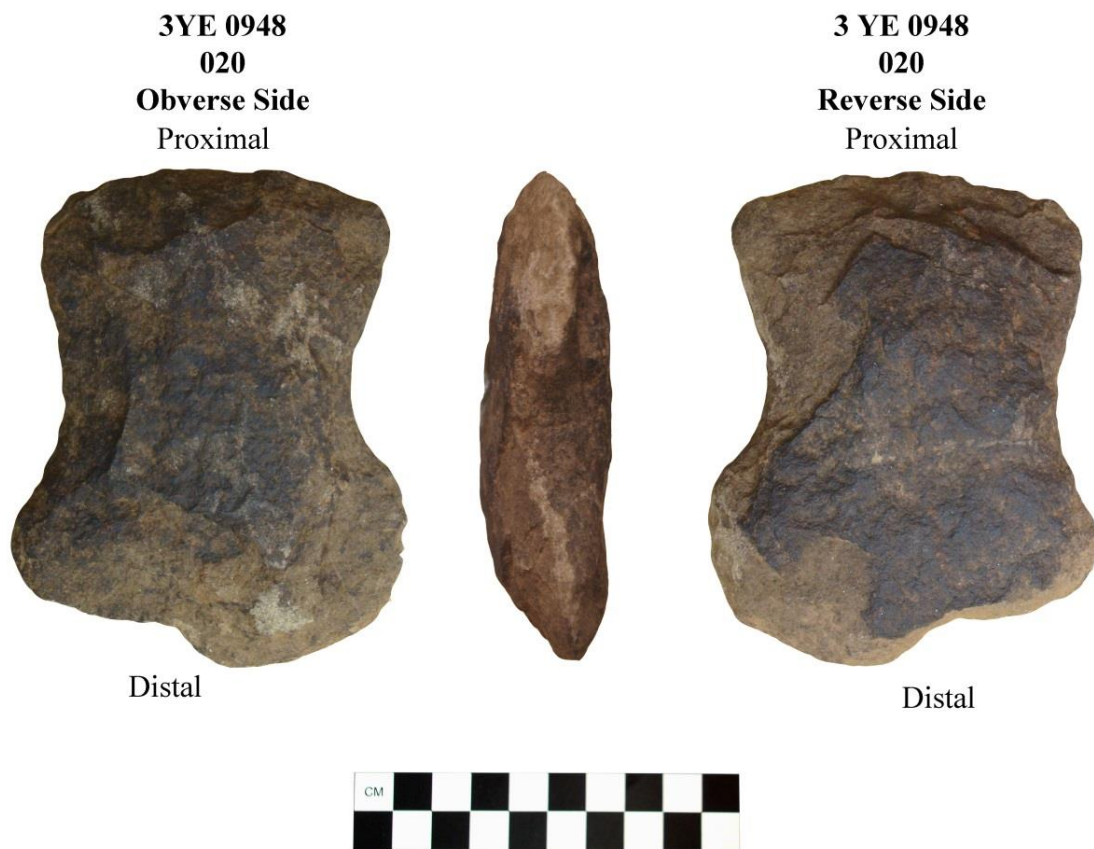


Figure 224. The obverse and reverse side of Artifact 020.

3YE 0948
020
Obverse Side

Proximal



Distal



Figure 225. Casting locations on the obverse side of Artifact 20.

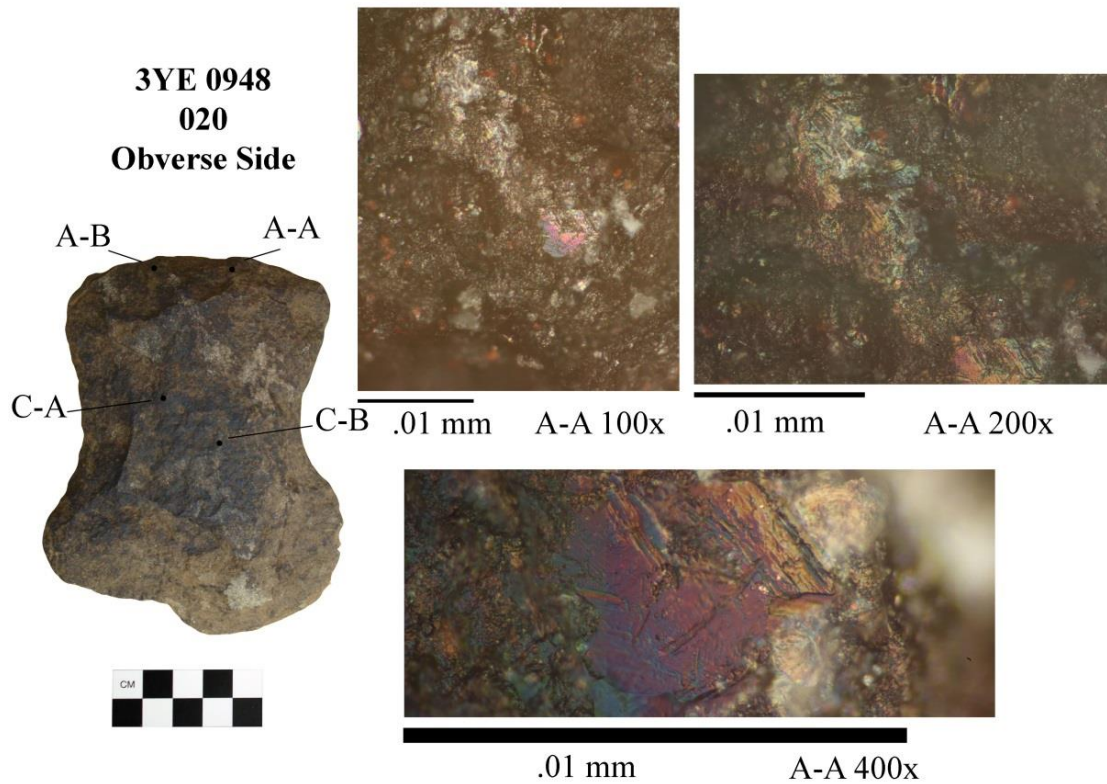


Figure 226. Bit edge wear on the obverse side of Artifact 020, Location A-A, showing microplating wear and light multi-directional wear.

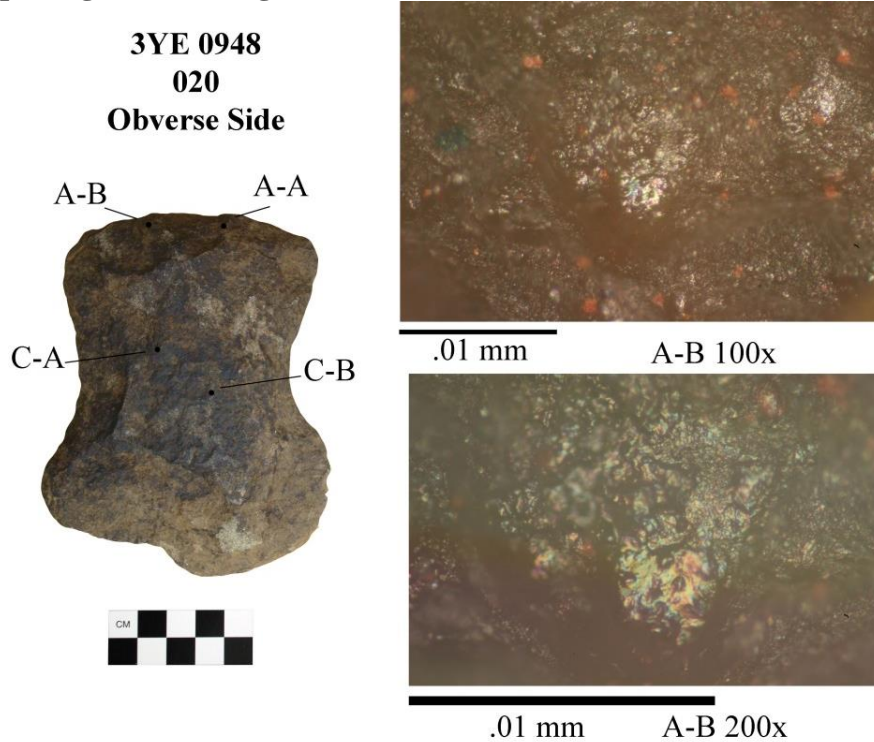


Figure 227. Bit edge wear on the obverse side of Artifact 020, Location A-B, showing microplating and light abrasive wear.

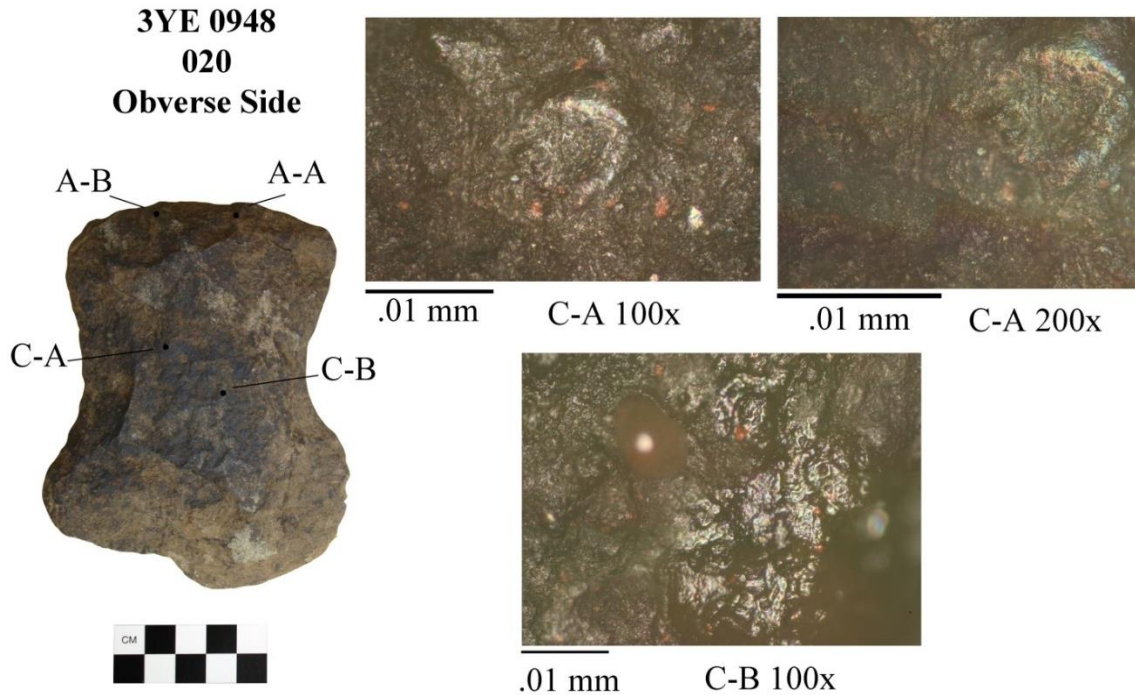


Figure 228. Hafting wear on the obverse side of Artifact 020, Locations C-A and C-B, showing generalized abrasion with the beginning of microplating on Location C-A and cast error with the presence of oil on Location C-B.

Artifact 021

Artifact 21 was a number given in the original collection by Mr. Darryl Smith; however, there was no tool that was marked for Artifact 021. The number was kept in the collection to avoid later confusion, as Artifact 021 exists; it just was not given with the rest of the collection.

Artifact 022

Artifact 022 is a small double bitted tool and was one of the only ones made of chert (Figure 229). Edges appear to have been heavily used and polishing evidence of hafting can be seen. Artifact 022 weighs 165.7 grams with a length of 91.0 mm, a maximum width of 71.2 mm and a thickness of 25.1 mm.

Casting

Three casts were taken from Artifact 022, a proximal (A), distal (B) and a haft (C), all from the obverse side. Cast #46, the obverse proximal was taken from Batch 9 and measures 39.66 mm in length and 26.52 mm in width. The obverse distal, Cast #47 was created out of Batch 11 and measures 25.79 mm in width and 29.37 mm in length. Cast #48, the obverse haft, was produced from Batch 8 and measures 42.18 mm in length and 36.62 mm in width (Figure 230).

Use-wear

Wear on this tool is different than what is seen on the rest of the collection. While the patterns are similar, presence of microplating and multi-directional striations, the chert material which this tool is made from produces wear which has slightly different characteristics. Bit wear consists of large planes of microplating with places of numerous multi-directional overlapping striations. The hafting wear shows additive microplating wear which has been heavy abraded with multiple overlapping multi-directional striations (Figures 231-241).

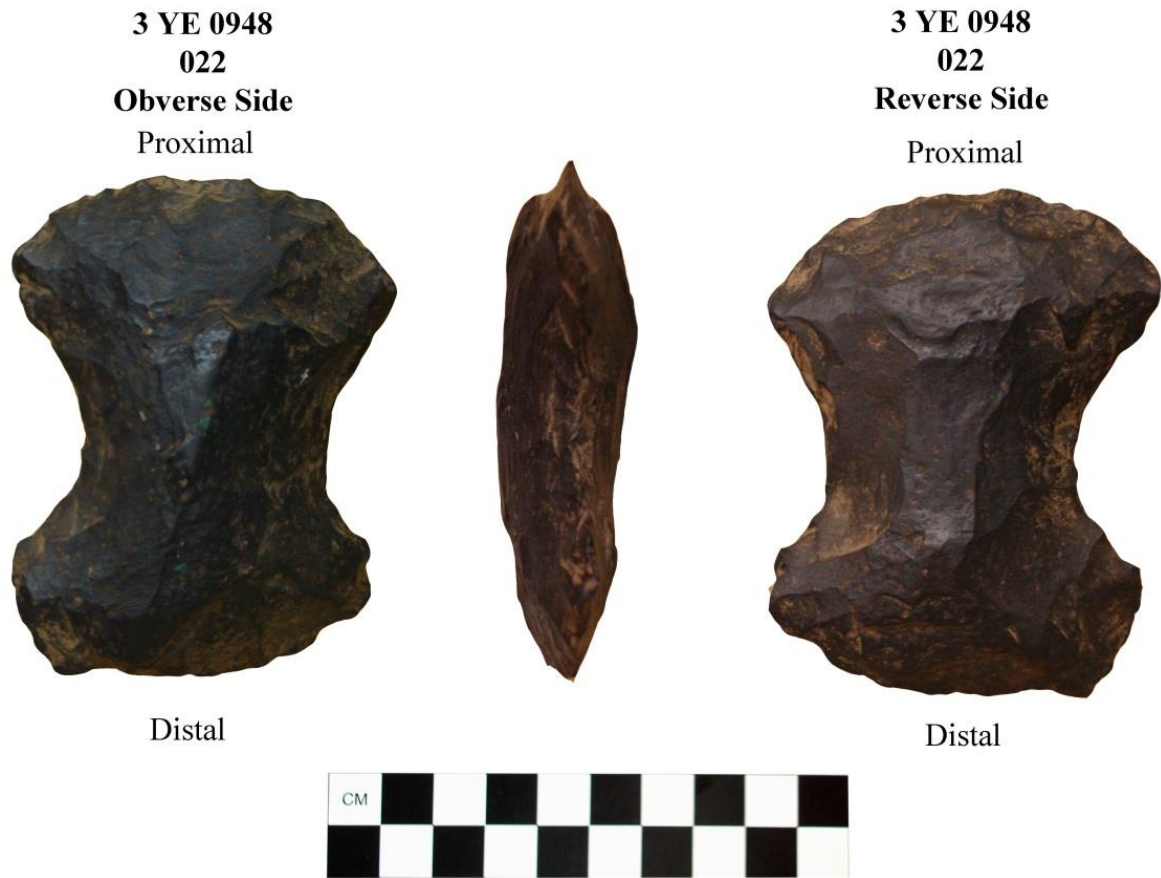


Figure 229. The obverse and reverse sides of Artifact 022.

3 YE 0948
022
Obverse Side
Proximal



Distal



Figure 230. Casting locations on the obverse side of Artifact 022.

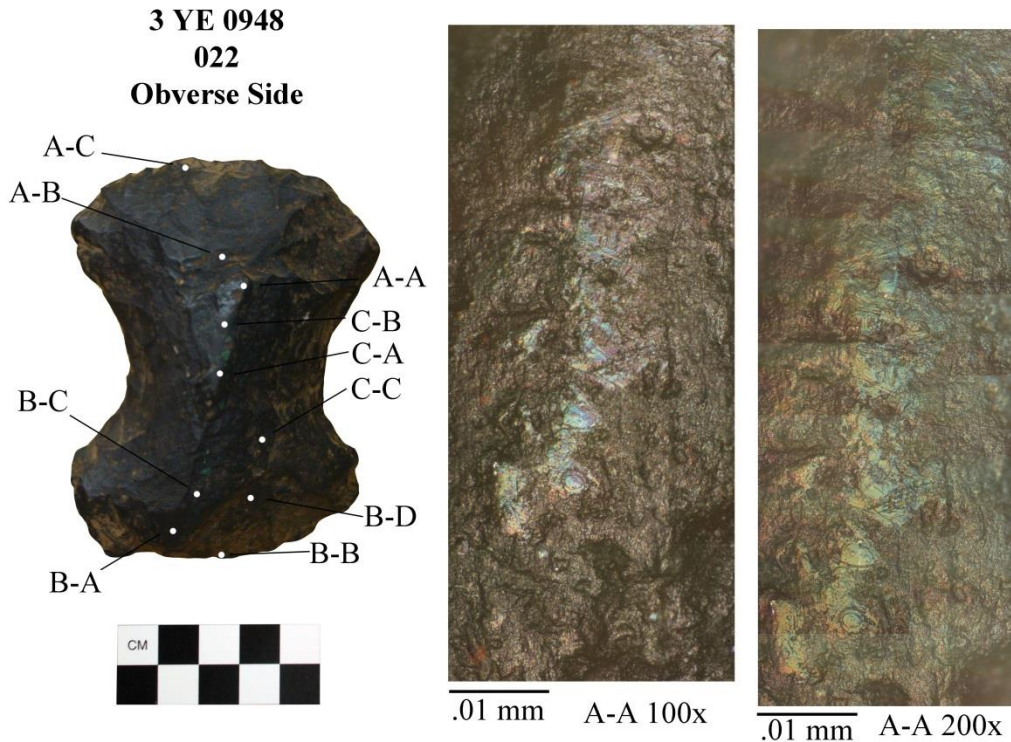


Figure 231. Bit edge wear on the obverse side of Artifact 022, Location A-A, showing a large plane of microplating and generalized abrasion with numerous multi-directional striations present.



Figure 232. Bit edge wear on the obverse side of Artifact 022, Location A-A, showing a greater magnification of the previous image with large microplating and numerous multi-directional striations.

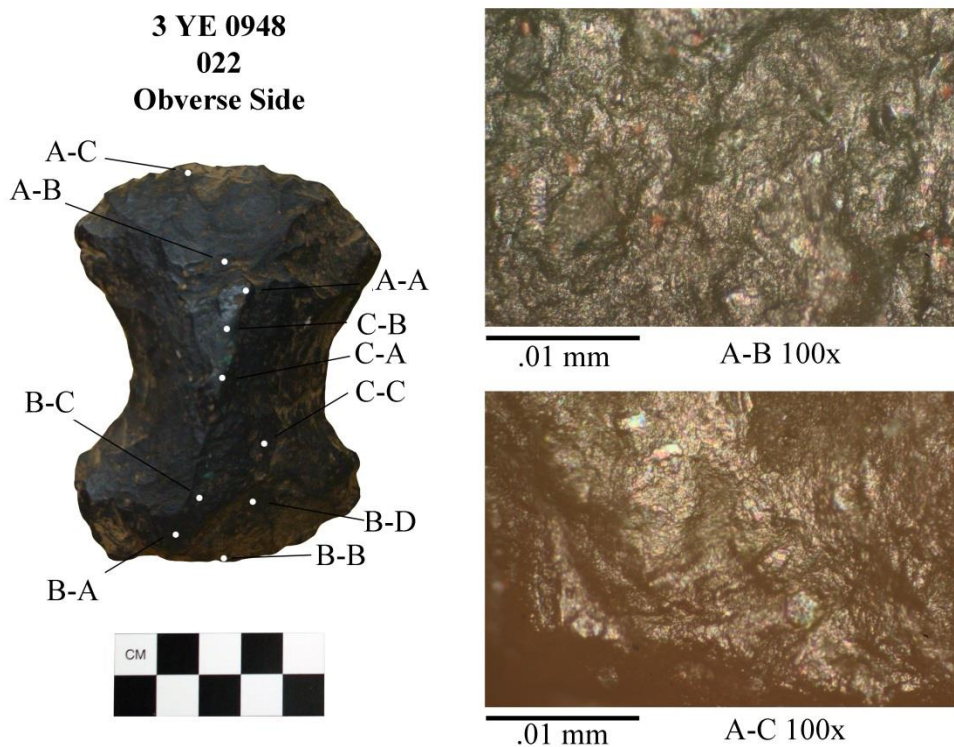


Figure 233. Bit edge wear on the obverse side of Artifact 022, Locations A-B and A-C, showing large sections of generalized abrasion with the beginnings of microplating.

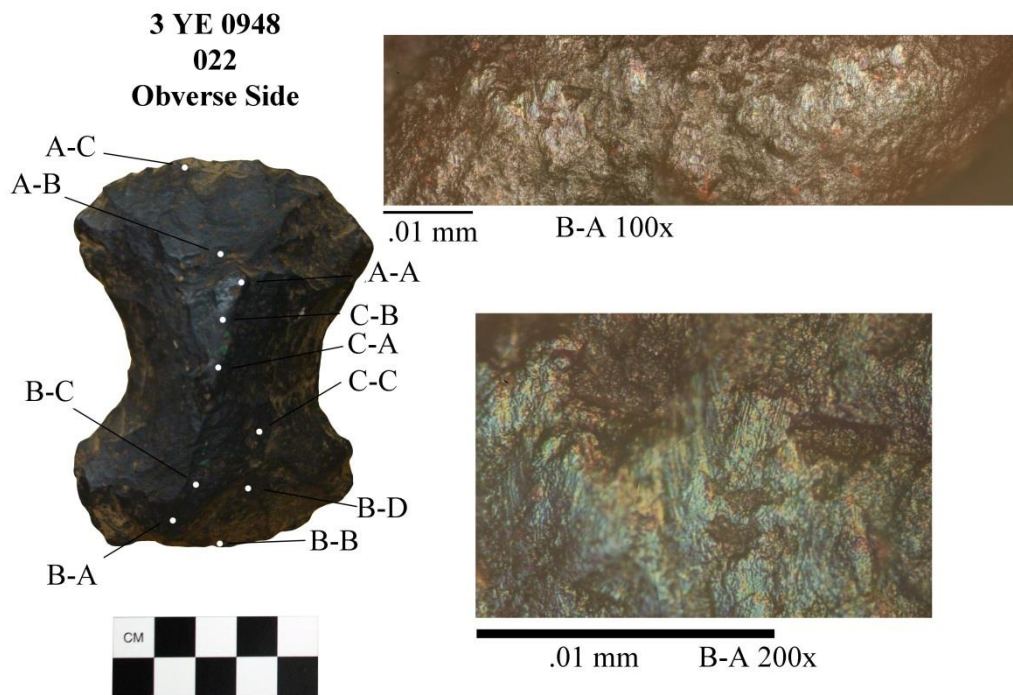


Figure 234. Bit edge wear on the obverse side of Artifact 022, Location B-A, showing large additive wear plane with striations generally running in a perpendicular direction to the bit edge.

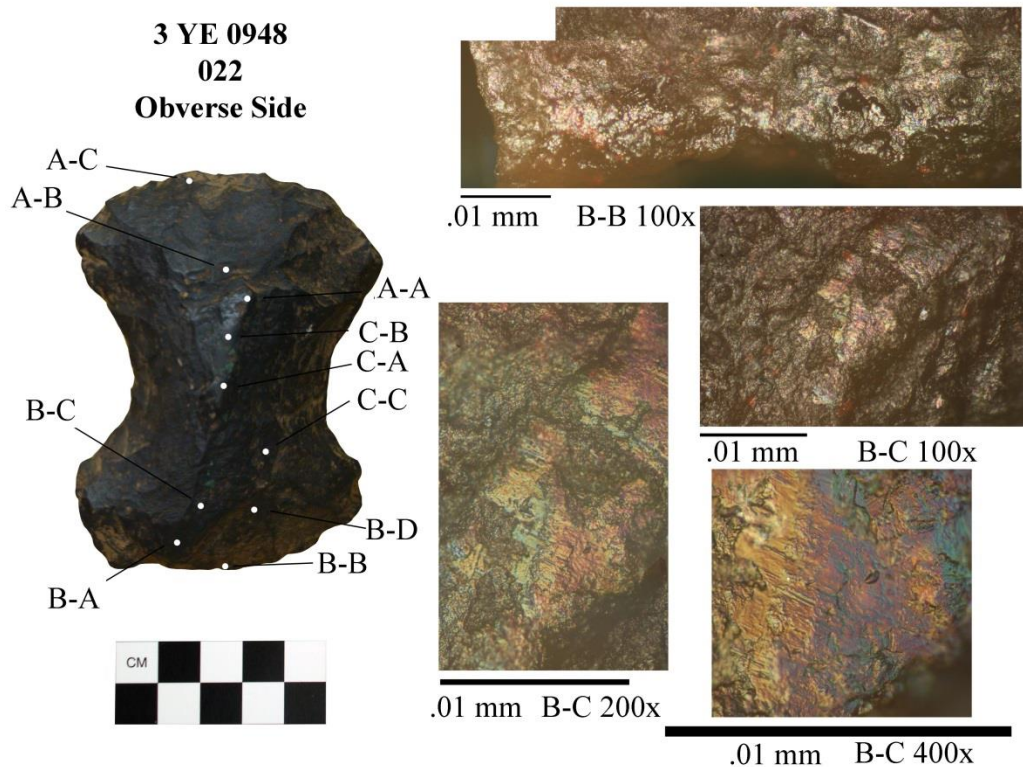


Figure 235. Bit edge wear on the obverse side of Artifact 022, Locations B-B and B-C, showing generalized abrasion and heavy microplating with obliquely directional striations.

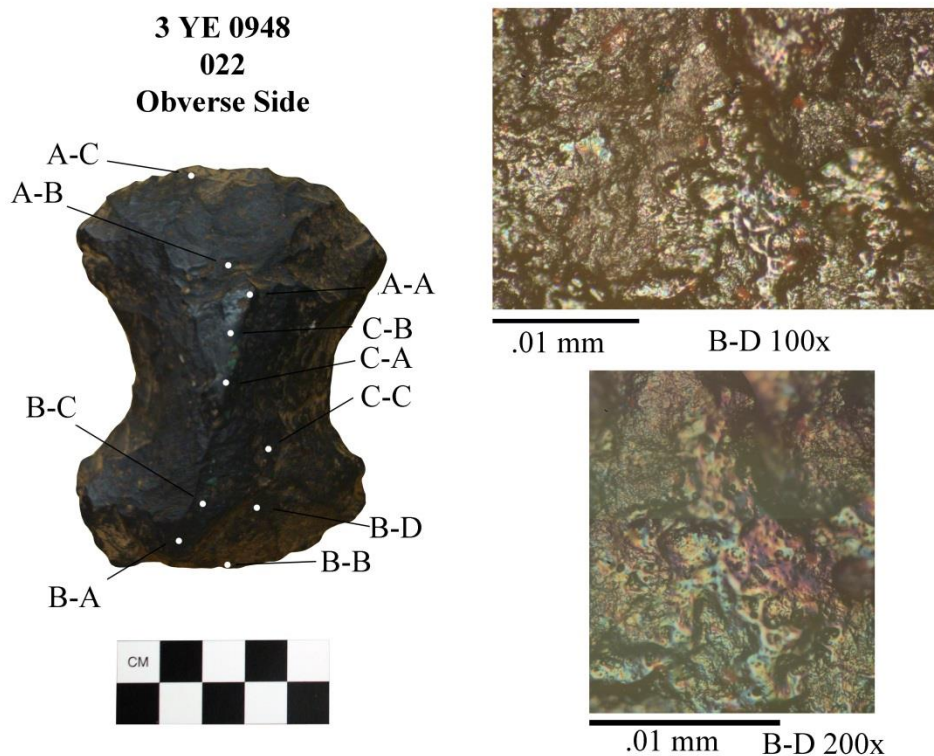


Figure 236. Casting error on the obverse side of Artifact 022, Location B-D, showing the presence of oil on the cast.



Figure 237. Hafting wear on the obverse side of Artifact 022, Location C-A, showing substantial abrasive and additive wear.

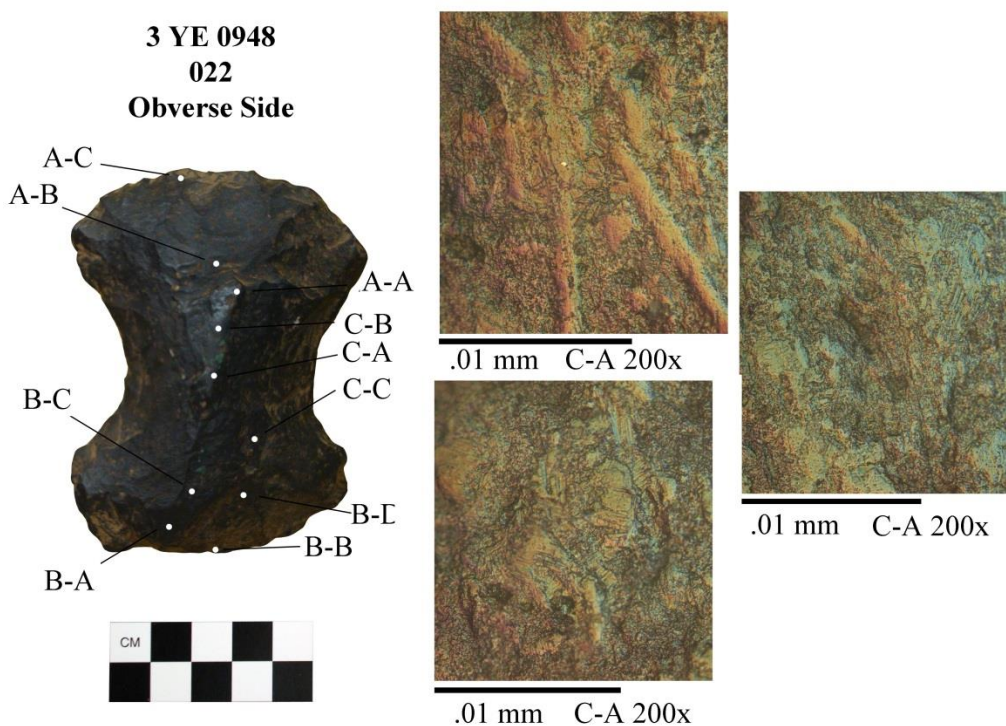


Figure 238. Hafting wear on the obverse side of Artifact 022, Location C-A at a higher magnification of the previous image, showing heavy abrasive wear and light multi-directional striations.

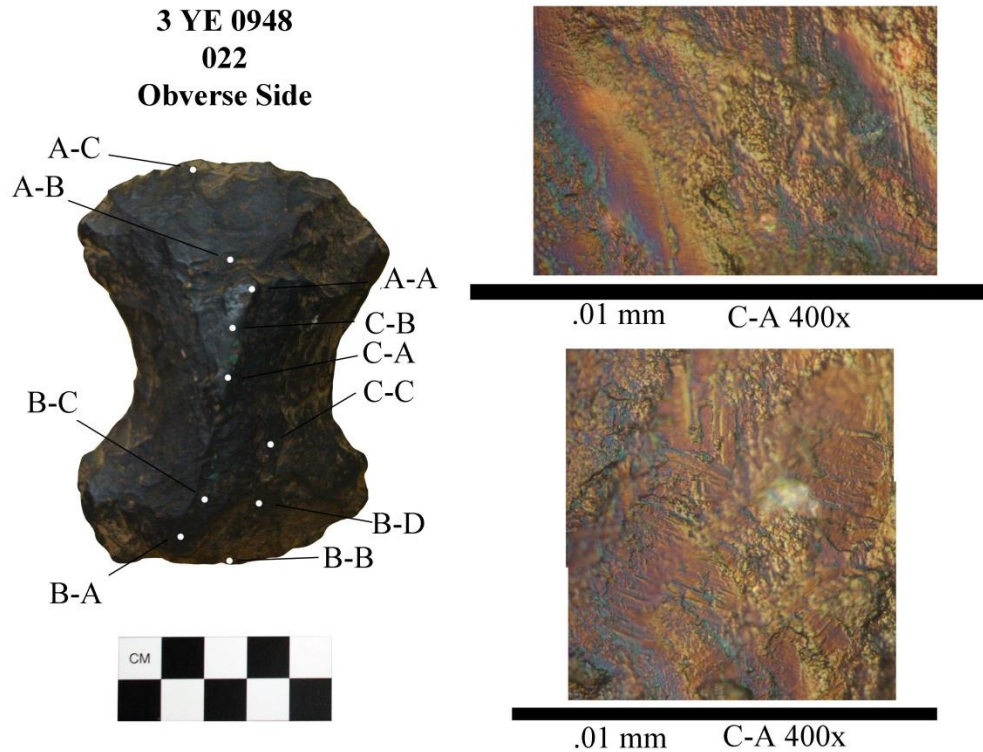


Figure 239. Hafting wear on the obverse side of Artifact 022, Location C-A at a higher magnification of the previous image, showing heavy abrasive wear.

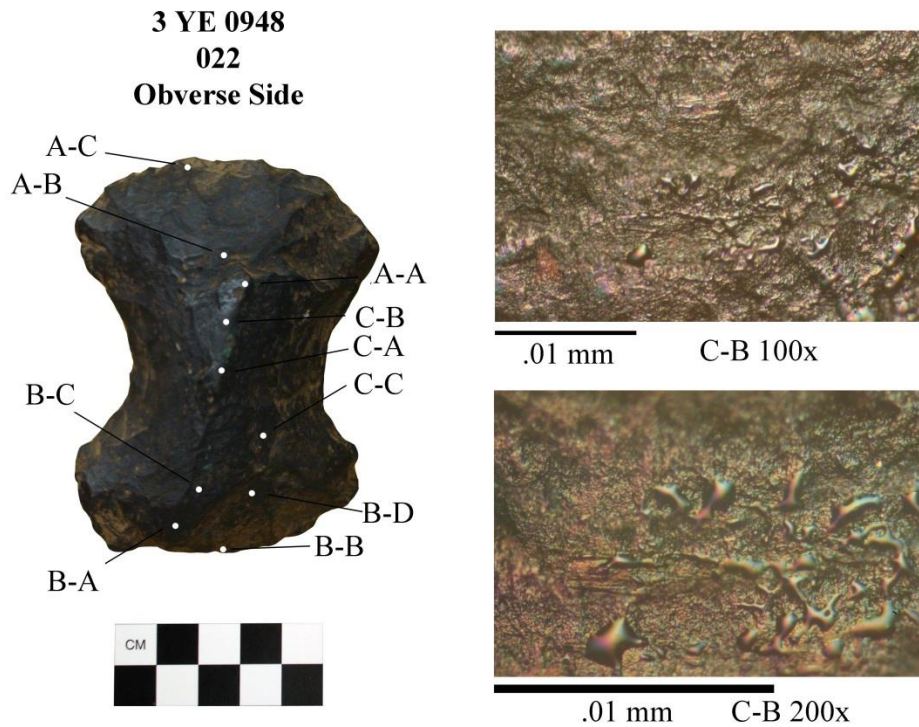


Figure 240. Casting error on the obverse side of Artifact 022, showing the presence of oil on the cast at Location C-B.

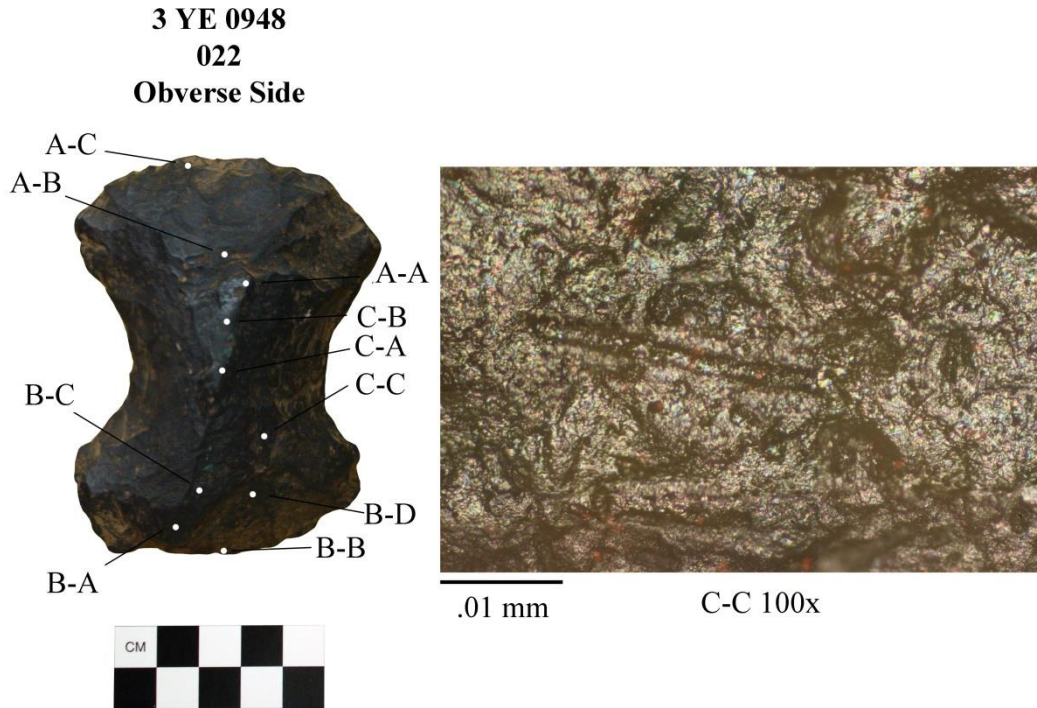


Figure 241. Hafting wear on the obverse side of Artifact 022, Location C-C, showing a large abrasive plane, with the beginnings of microplating.

Artifact 023

Artifact 023 is a complete double bitted tool made of silicified sandstone (Figure 242). The artifact sustained damage after collection and a small piece of the obverse proximal prong has broken off. Both proximal and distal edges are well rounded and show significant grinding wear. The proximal edge has a step fracture which most likely occurred during repair of the tool. The hafting portion shows some polishing. Artifact 023 weighs 148.8 grams, with a length of 89.2 mm, a width of 58.9 mm and the maximum thickness of 25.6 mm.

Casting

A total of three casts were taken from Artifact 023, a proximal (A), a distal (B) and a haft (C), all of which were taken from the obverse side. Cast #49, the obverse proximal, was created from Batch 11 and measures 19.8 mm in length and 39.62 mm in width. The obverse distal, Cast

#50, was taken from Batch 11 and measures 22.84 mm in length and 39.66 mm in width. Cast #51, the obverse haft, was produced from Batch 7 and measure 44.08 mm in length and 32.64 mm in width (Figure 243).

Use-wear

Bit edge wear consists of microplating wear with few striations present and generalized abrasion. Wear seen in the hafting portion shows large portions of microplating and generalized abrasion (Figures 244- 247).



Figure 242. The obverse and reverse sides of Artifact 023.

3 YE 0948
023
Obverse Side

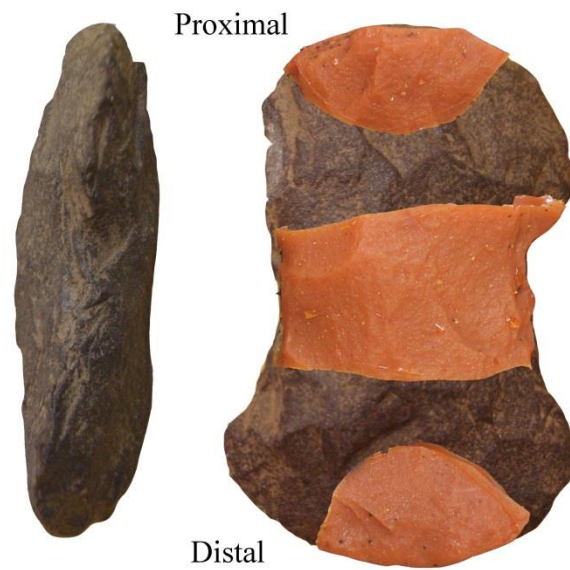


Figure 243. Casting locations on the obverse side of Artifact 023.

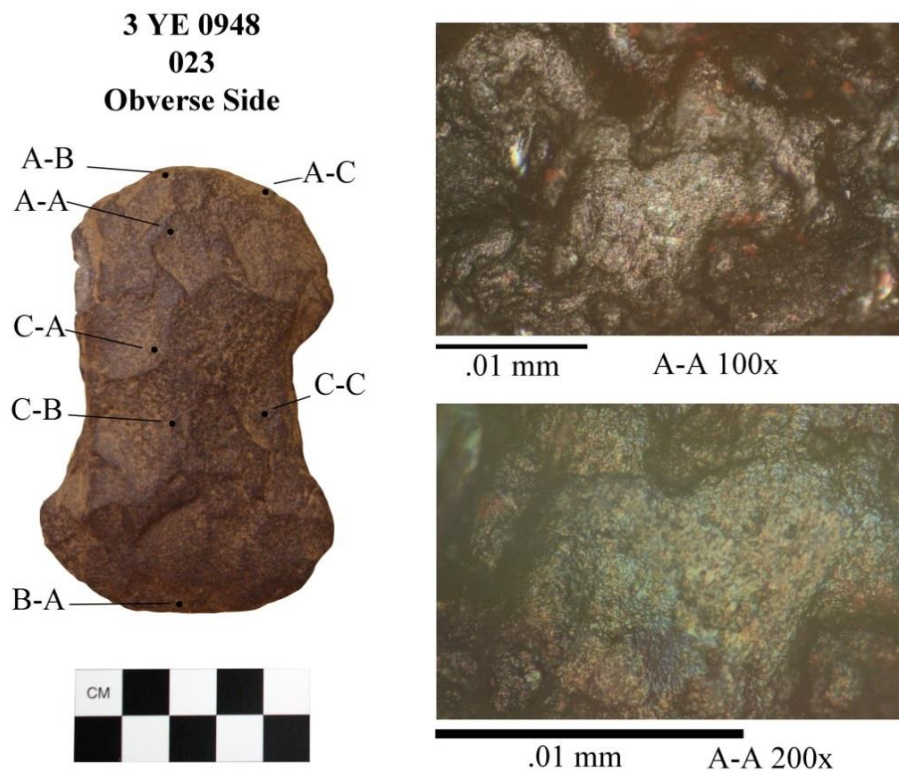


Figure 244. Bit edge wear on the obverse side of Artifact 023, Location A-A, showing abrasive wear with the beginnings of microplating.



Figure 245. Bit edge wear on the obverse side of Artifact 023, showing additive microplating wear with few striations present.

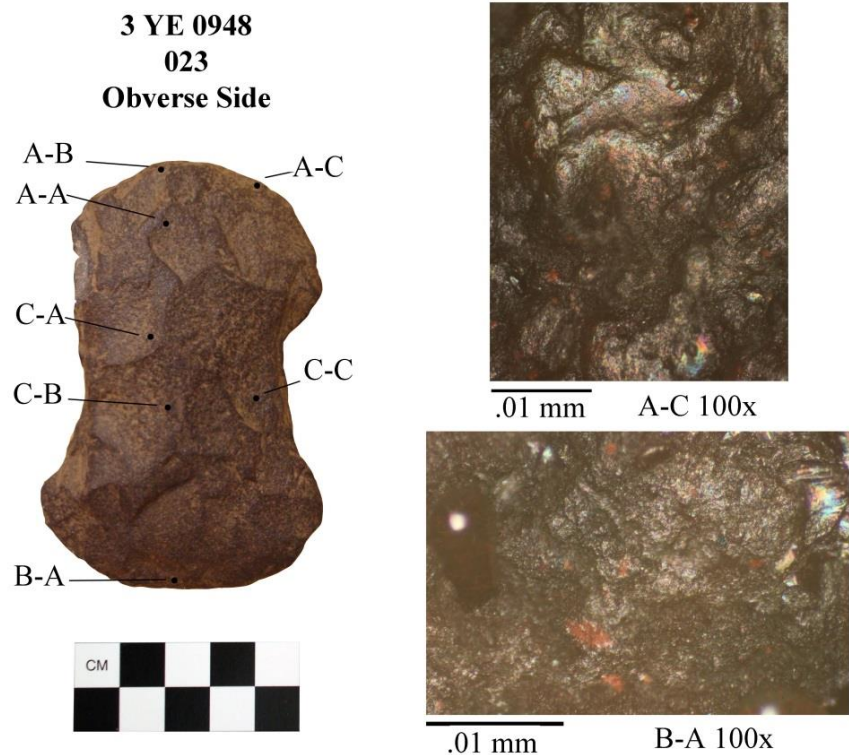


Figure 246. Bit edge wear on the obverse side of Artifact 023, Locations A-C and B-A, showing generalized abrasion and microplating wear.

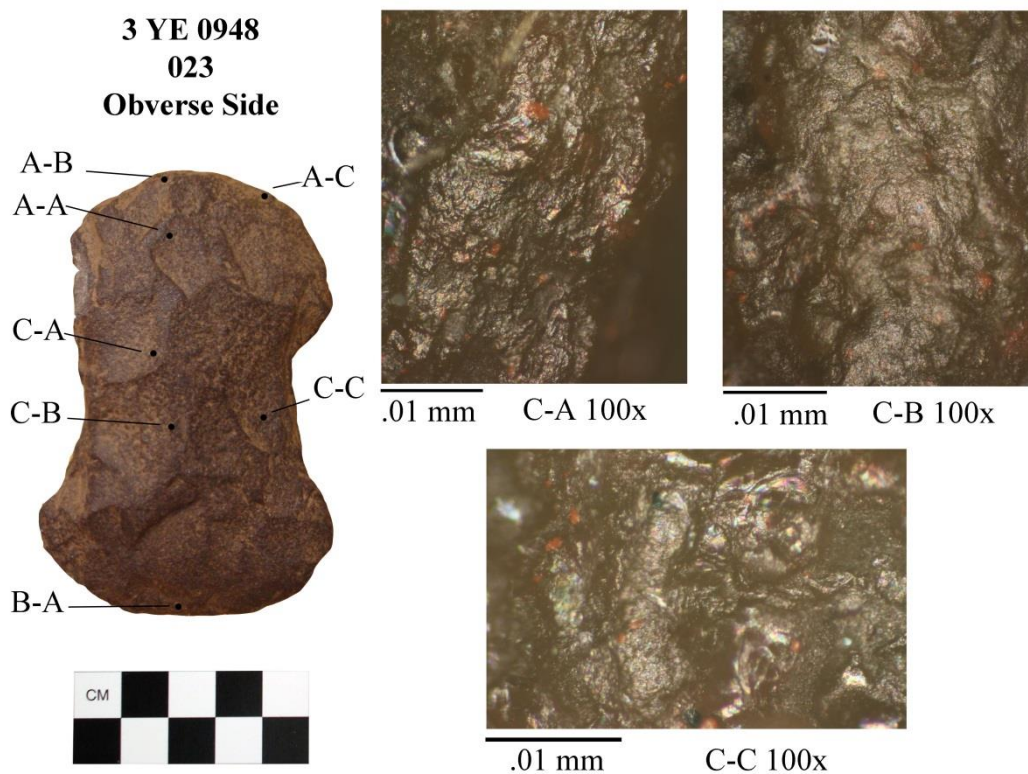


Figure 247. Hafting wear on the obverse side of Artifact 023, Location C-A, C-B and C-C, showing directional microplating wear.

Artifact 024

Artifact 024 is a broken portion of a double bitted tool (Figure 248). A portion of the hafting area and the proximal edge is intact. The tool edge is rounded and shows smoothing. The tool is made up of silicified sandstone and polish can be seen in multiple locations on either side. The bending fracture on the hafting portion suggests the tool failed during use a twisting on impact. Once the tool failed, it was modified for continued used as most likely a wedge. The broken edge shows evidence of impact flakes, as well as impact marks. Artifact 024 weighs 157.2 grams, with a length of 80.9 mm, a width of 65.9 mm and a maximum thickness of 27.4 mm.

Casting

Only one cast was taken from Artifact 24, an obverse proximal created from Batch 1. This is Cast #52, which measures 42.92 mm in length and 45.03 mm in width (Figure 249).

Use-wear

Wear on this tool shows directional smoothing of previous microplating wear, potential caused from the modification of the tool. These large abrasive planes have few small striations present (Figures 250-251).



Figure 248. The obverse and reverse side of Artifact 024.

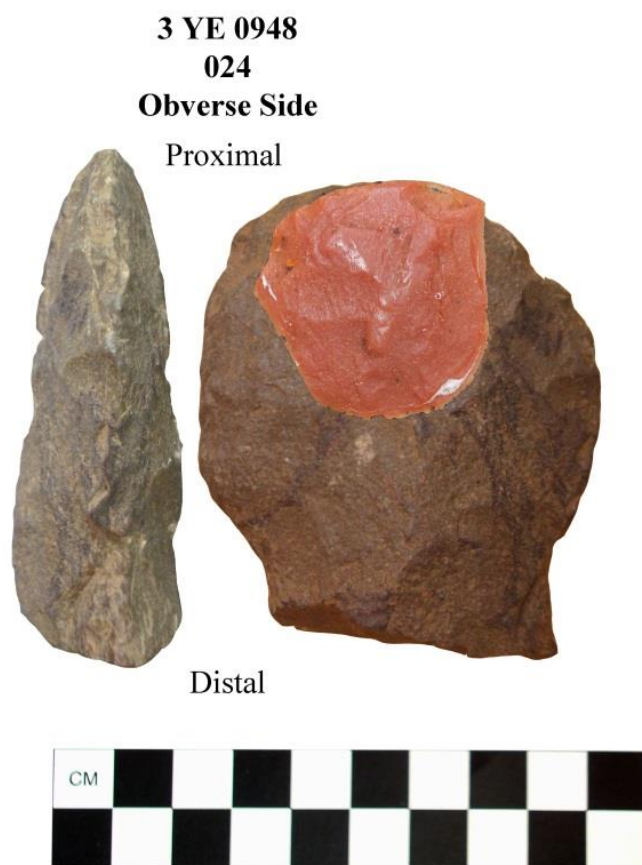


Figure 249. Casting location on the obverse side of Artifact 024.

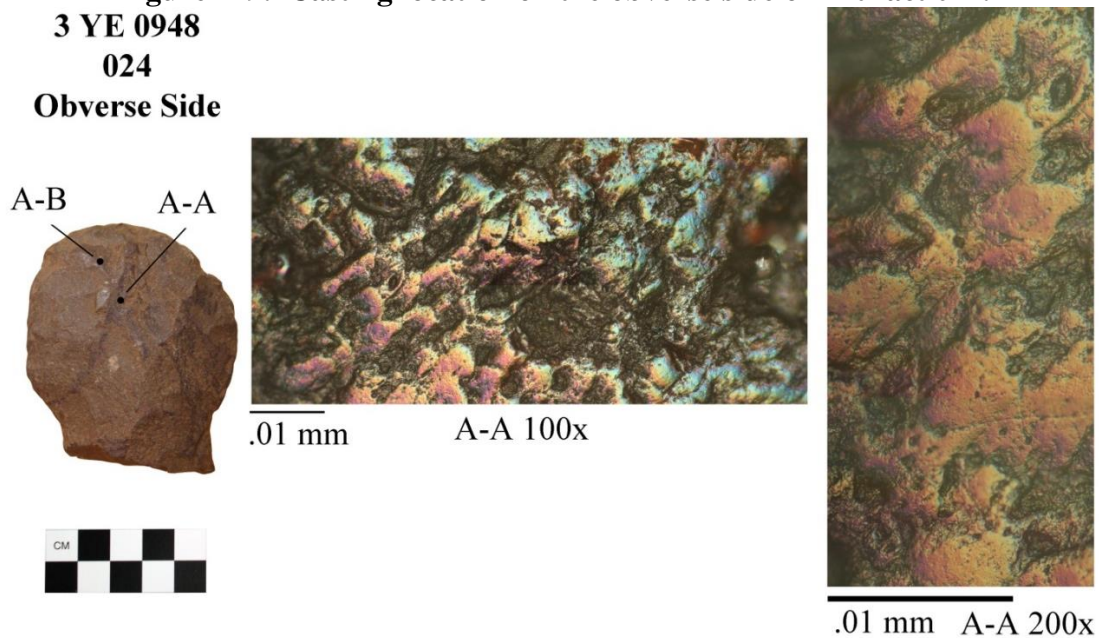


Figure 250. Bit edge wear on the obverse side of Artifact 024, Location A-A, showing directional abrasive wear smoothing previous microplating wear.

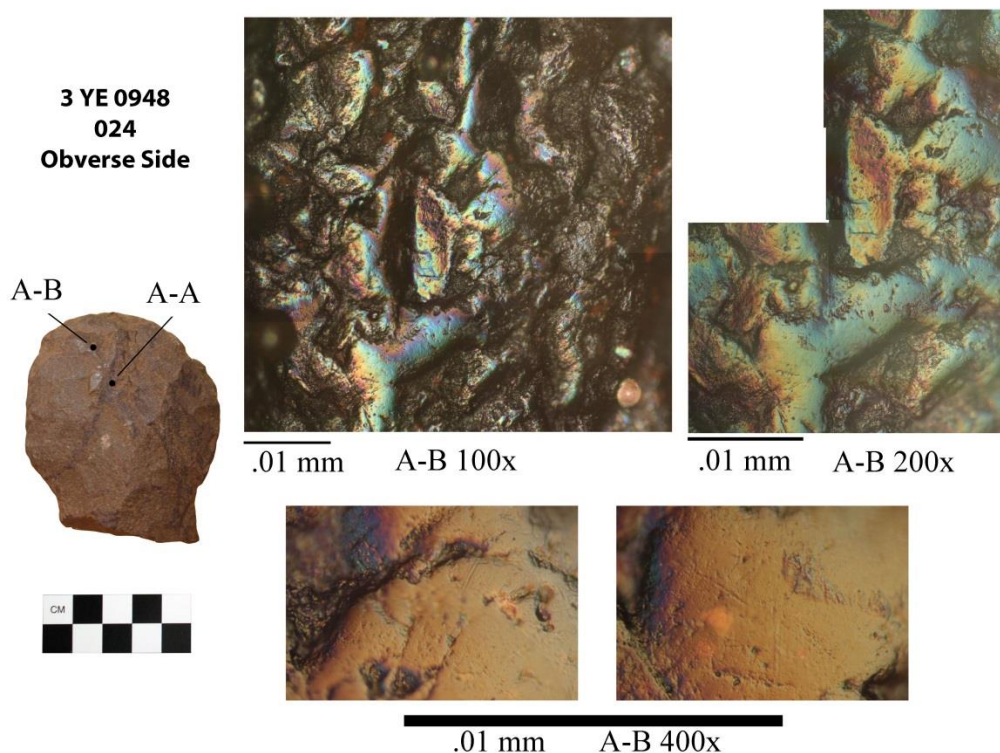


Figure 251. Bit edge wear on the obverse side of Artifact 024, Location A-B, showing directional abrasive wear smoothing previous microplating wear with few light striations.

Artifact 025

Artifact 025 is a damaged double bitted tool with portions of the hafting and the proximal edge still intact (Figure 252). This tool is made of silicified sandstone and shows considerable polish wear in the hafting area and on surface portions near the bit. The edges appear to have significant smoothing and grinding. Artifact 025 weighs 106.4 grams with a length of 68.3 mm, a width of 66.0 mm and a thickness of 17.7 mm.

Casting

Artifact 025 had two casts taken, a proximal (A) and a haft (C), both from the obverse side. Cast # 53, the obverse proximal was created out of Batch 5 with the length of 26.05 mm and the width of 32.42 mm. Cast #54, the obverse haft, was taken from Batch 7 and measures 58.72 mm in length by 31.1 mm in width (Figure 253).

Use-wear

Bit edge wear shows substantial microplating with numerous multi-directional striations. Many of the striations are overlapping or partially filled in. Hafting wear has large portions of microplating and some light generalized abrasion. Locations of microplating with directional striations can also be seen (Figures 254-259).

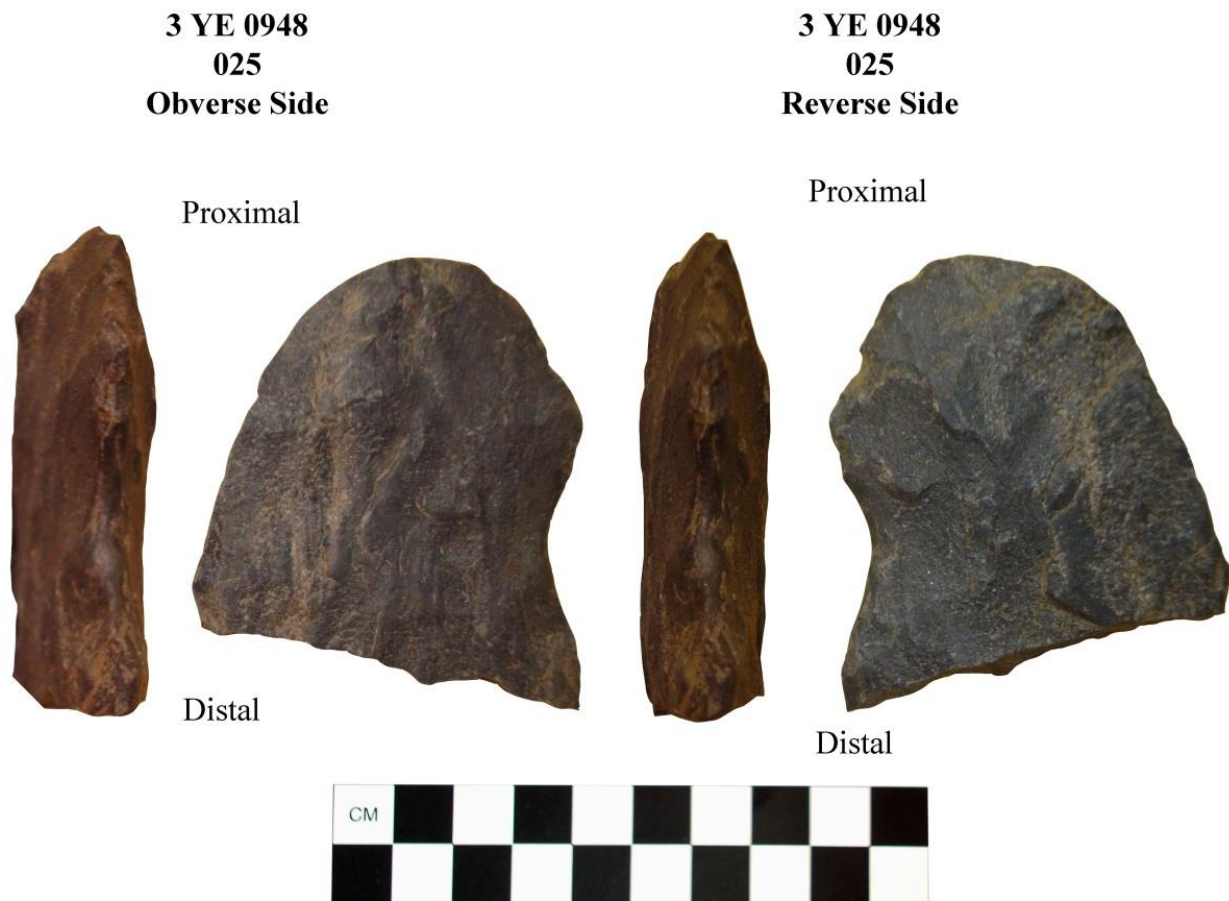


Figure 252. The obverse and reverse side of Artifact 025.

**3 YE 0948
025
Obverse Side**



Figure 253. Casting locations on the obverse side of Artifact 025.

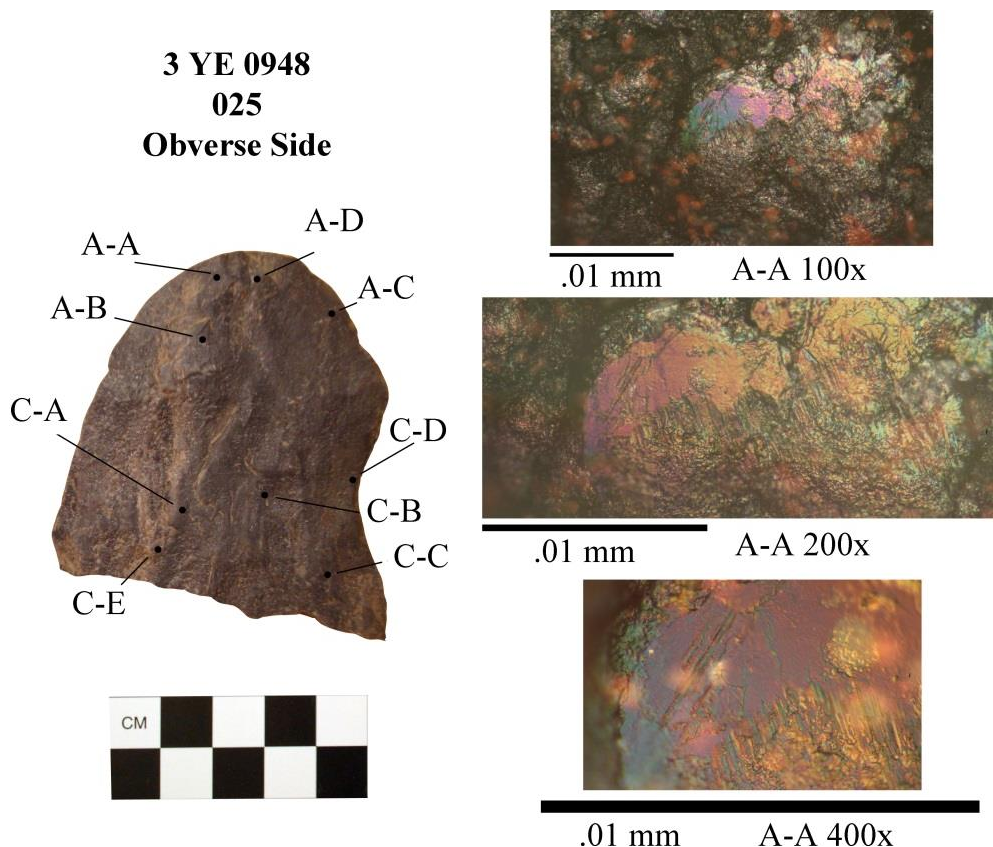


Figure 254. Bit edge wear on the obverse side of Artifact 025, Location A-A, showing heavy microplating wear with multi-directional striations.

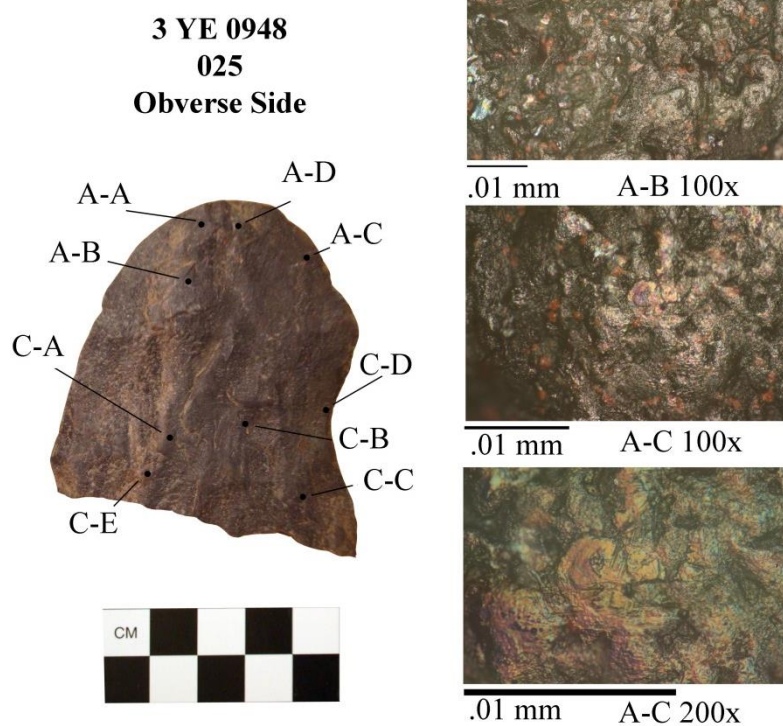


Figure 255. Bit edge wear on the obverse side of Artifact 025, Location A-B and A-C, showing heavy microplating wear with multi-directional striations.

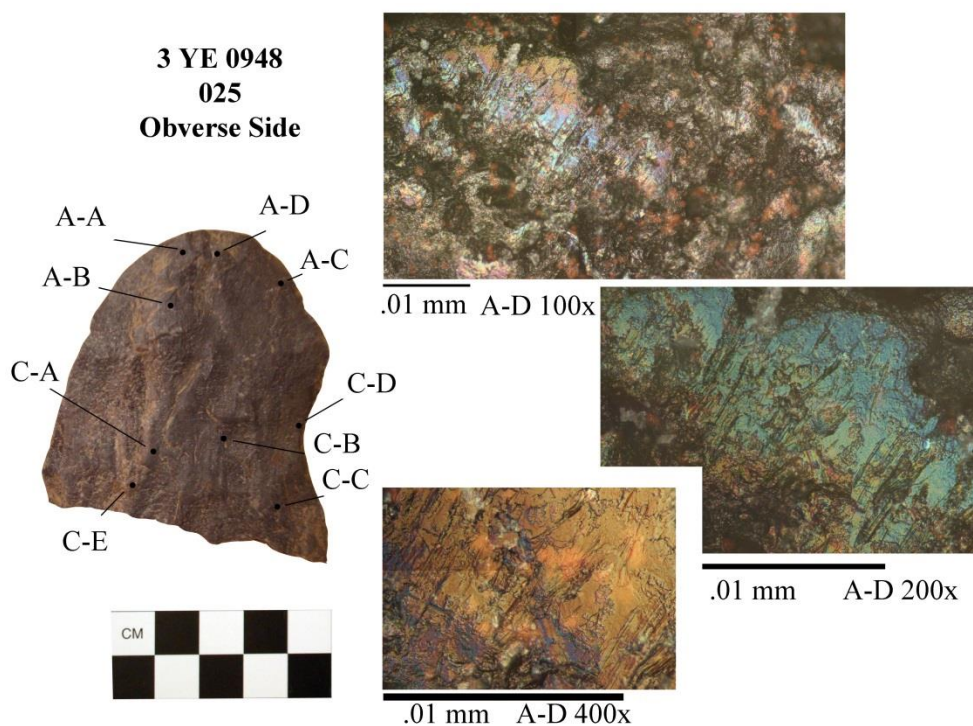


Figure 256. Bit edge wear on the obverse side of Artifact 025, Location A-D, showing heavy microplating wear with numerous striations running obliquely to the tool edge.

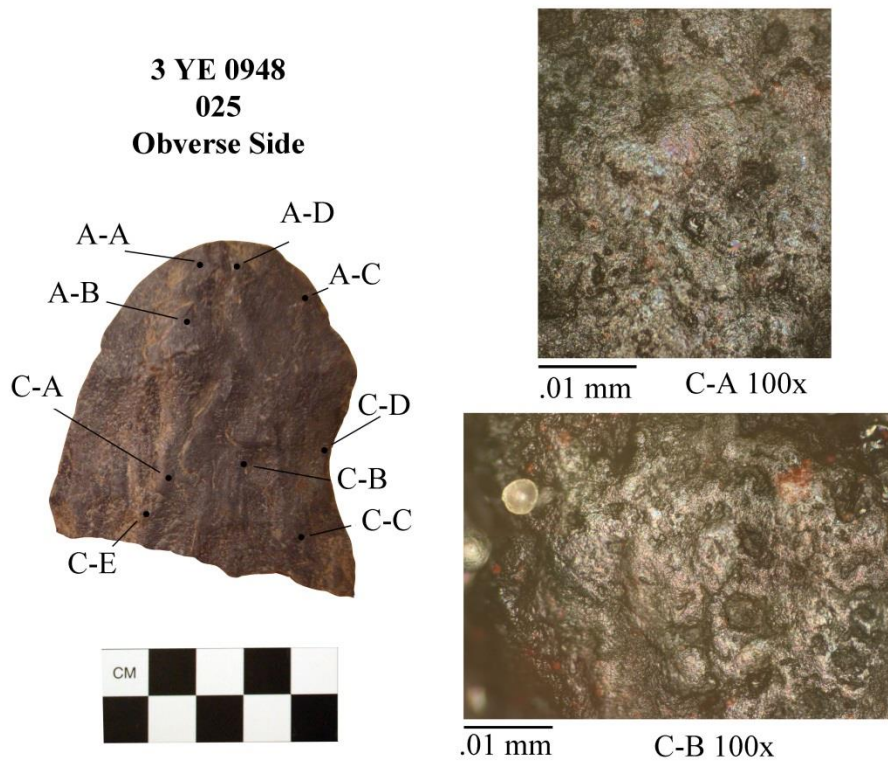


Figure 257. Hafting wear on the obverse side of the Artifact 025, Locations C-A and C-B, showing directional abrasion with the beginnings of microplating.

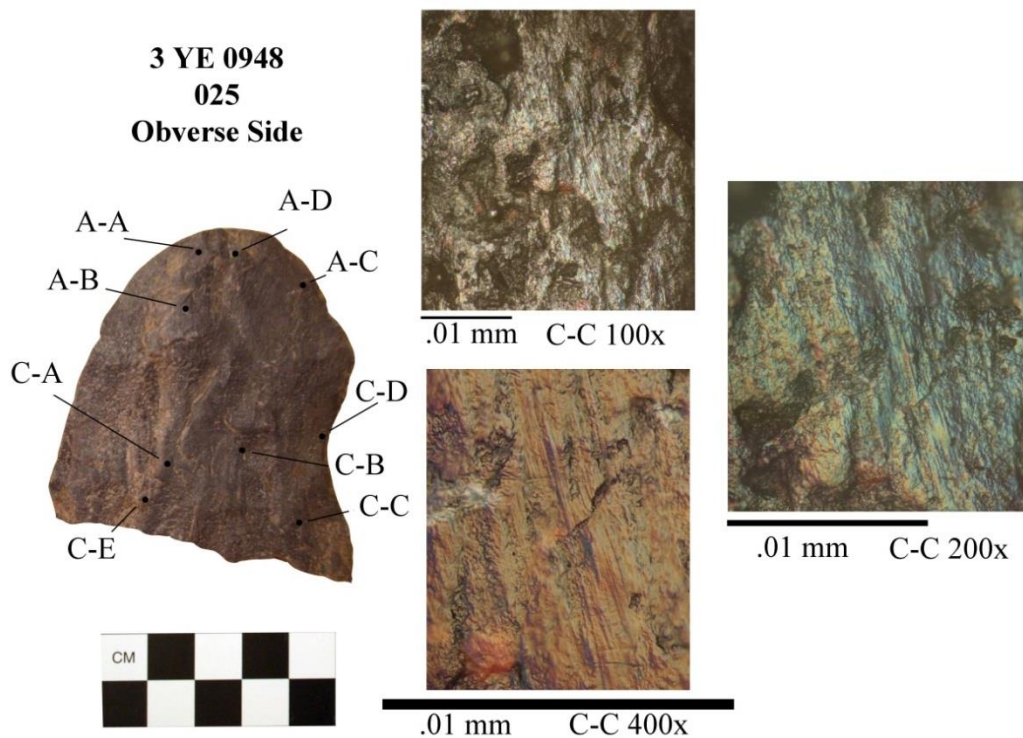


Figure 258. Hafting wear on the obverse side of Artifact 025, Location C-C, showing a large plane of microplating wear which has been abraded smooth with directional striations running perpendicular to the bit edge.

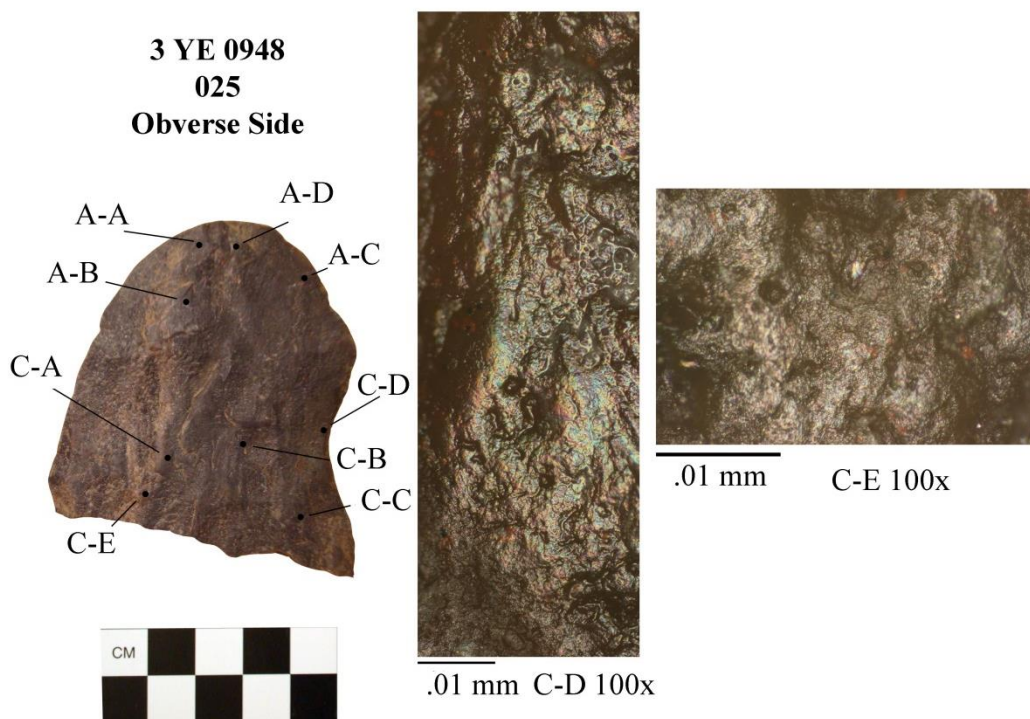


Figure 259. Hafting wear and casting error on the obverse side of Artifact 025, Locations C-D and C-E. The casting error of the presence of oil can be seen in Location C-D. C-E shows generalized abrasion with the beginnings of microplating.

Artifact 026

Artifact 026 is broken half of a double bitted tool made of silicified sandstone (Figure 260). The proximal edge and a portion of the hafting area are intact. The edges are sharp with little grinding. Tool was most likely damaged during use based off of the bending fracture at the hafting location. After rejection of use as a double bitted tool, the tool was potentially modified into a wedge form tool. Evidence of smoothing along the broken edge suggests impact use. And there are multiple step fractures along the obverse side of the tool and the reverse side has a large flake scar located near the bit edge. Artifact 026 weighs 119.8 grams, with a length of 72.5 mm, a width of 63.5 mm and a maximum thickness of 22.5 mm.

Casting

Two casts were taken from Artifact 026, a proximal (A) and a haft (C), both from the obverse side of the tool. Cast # 55, the obverse proximal was created from Batch 2 with a length of 28.99 mm and a width of 50.29 mm. Cast # 56, the obverse haft, was taken from Batch 6 and measures 57.16 mm in length and 19.48 mm in width (Figure 261).

Use-wear

Bit edge wear consists of large microplating wear which has been smoothed due to later abrasive wear and some light generalized abrasion. The hafting area shows microplating wear with some light generalized abrasion and few striations (Figures 262-264).



Figure 260. The obverse and reverse sides of Artifact 026.

3 YE 0948
026
Obverse Side

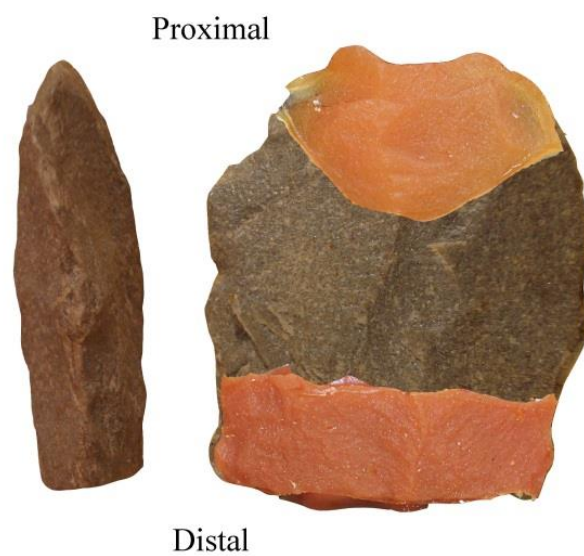


Figure 261. Casting locations on the obverse side of Artifact 026.

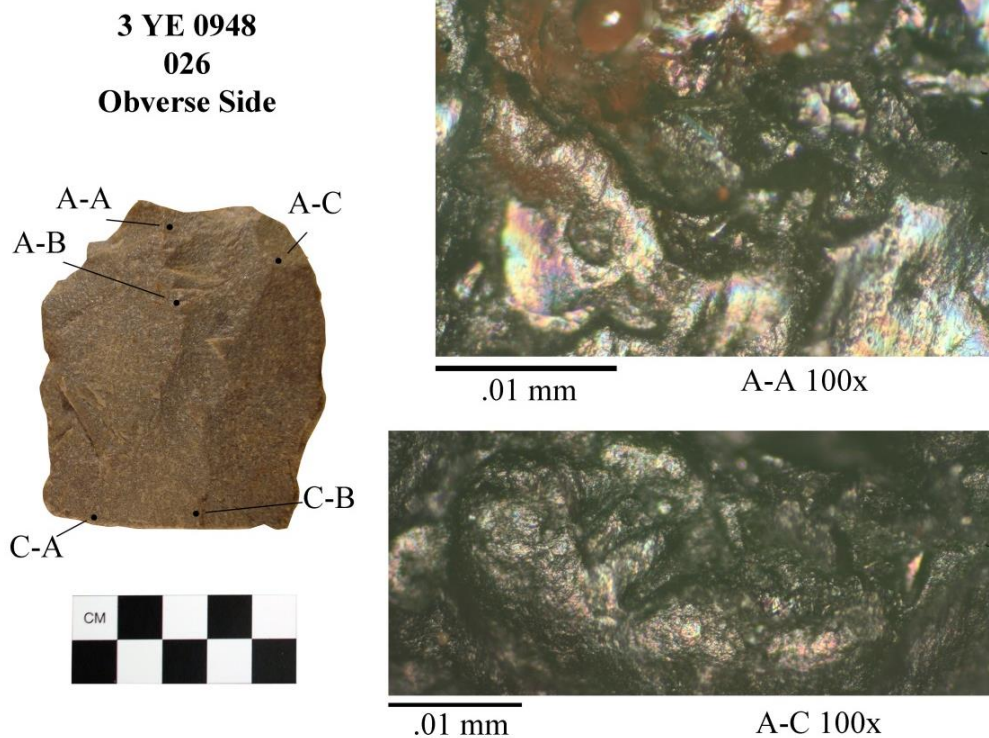


Figure 262. Bit edge wear on the obverse side of Artifact 026, Location A-A and A-C, showing generalized abrasion and light microplating.

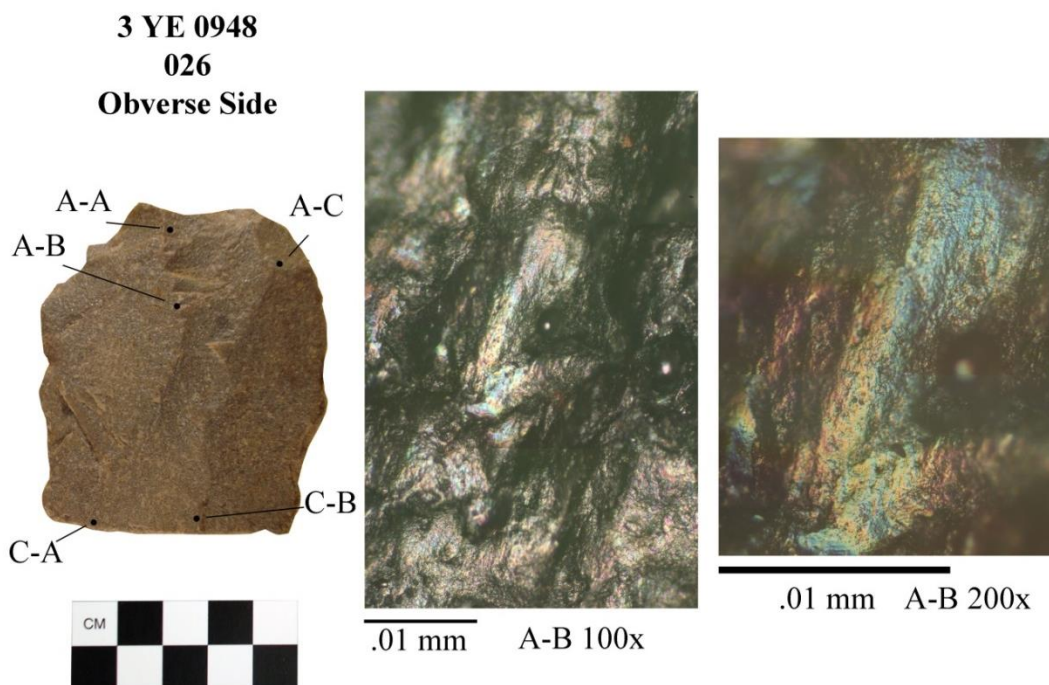


Figure 263. Bit edge wear on the obverse side of Artifact 026, Location A-B, showing heavy microplating wear.

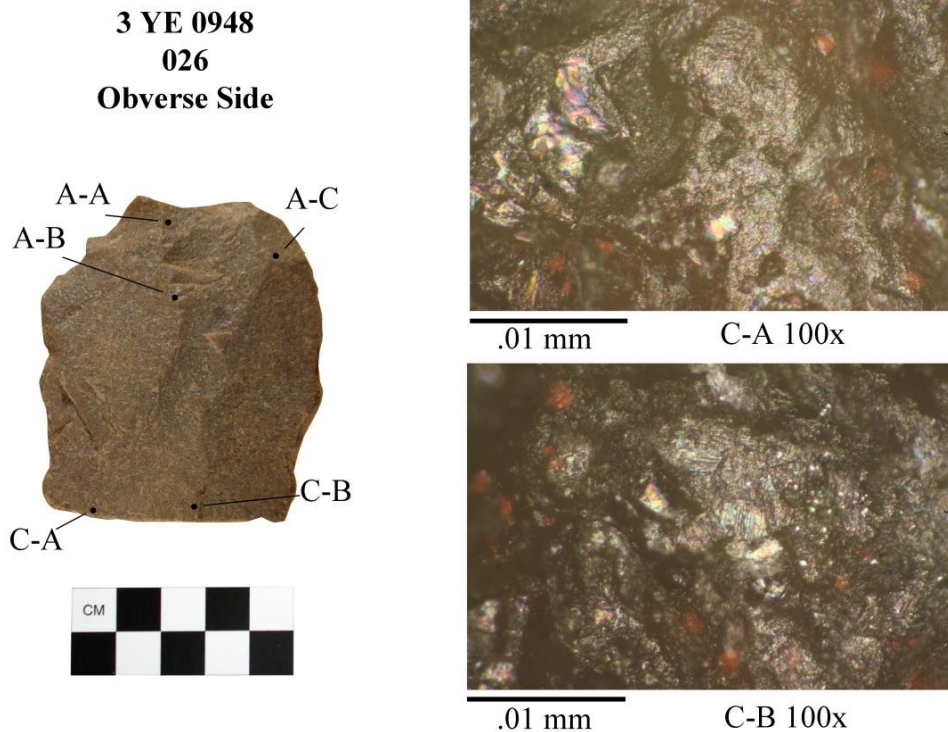


Figure 264. Hafting wear on the obverse side of Artifact 026, Location C-A and C-B, showing generalized abrasion, microplating, and light striations.

Artifact 027

Artifact 027 is a broken half of a double bitted tool made of silicified sandstone (Figure 265). The proximal side and a portion of the hafting are intact. Damage can be seen on one of the prongs where the piece broke off and damaged the tool. There is hafting polish present on the tool and the edges have some grinding present. Artifact 027 weighs 136.9 grams with a length of 65.2 mm, a width of 69.0 mm and a thickness of 26.6 mm.

Casting

A total of two casts were taken from Artifact 027, a proximal (A) and a haft (C), both from the obverse side. Cast #57, the obverse proximal, was taken from Batch 1. The length measured 27.82 mm and the width 35.63 mm. Cast #58, the obverse haft, was created from Batch 8 and measures 66.87 mm in length and 27.14 mm in width (Figure 266).

Use-wear

Bit edge wear on this tool is minimal, with few locations showing light microplating. Hafting wear showing large microplating planes with striations running perpendicular to the longitudinal axis of the tool (Figures 267-269).



Figure 265. The obverse and reverse side of Artifact 027.

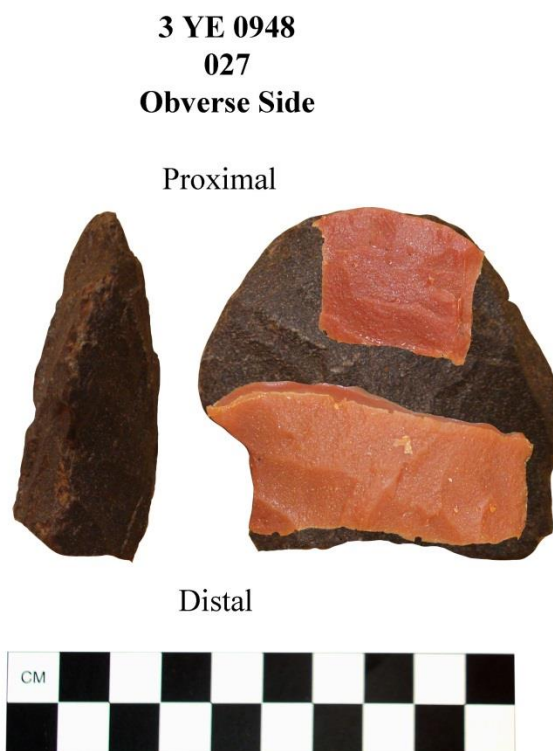


Figure 266. Casting locations on the obverse side of Artifact 027.

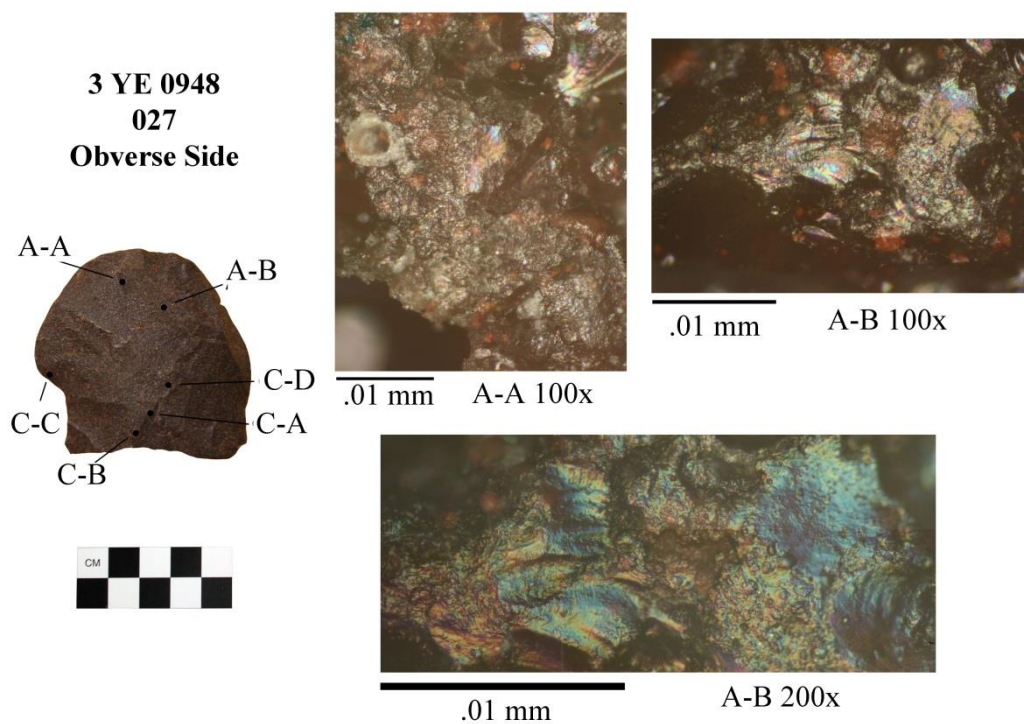


Figure 267. Bit edge wear on the obverse side of Artifact 027, Location A-A and A-B, showing microplating and generalized abrasion.

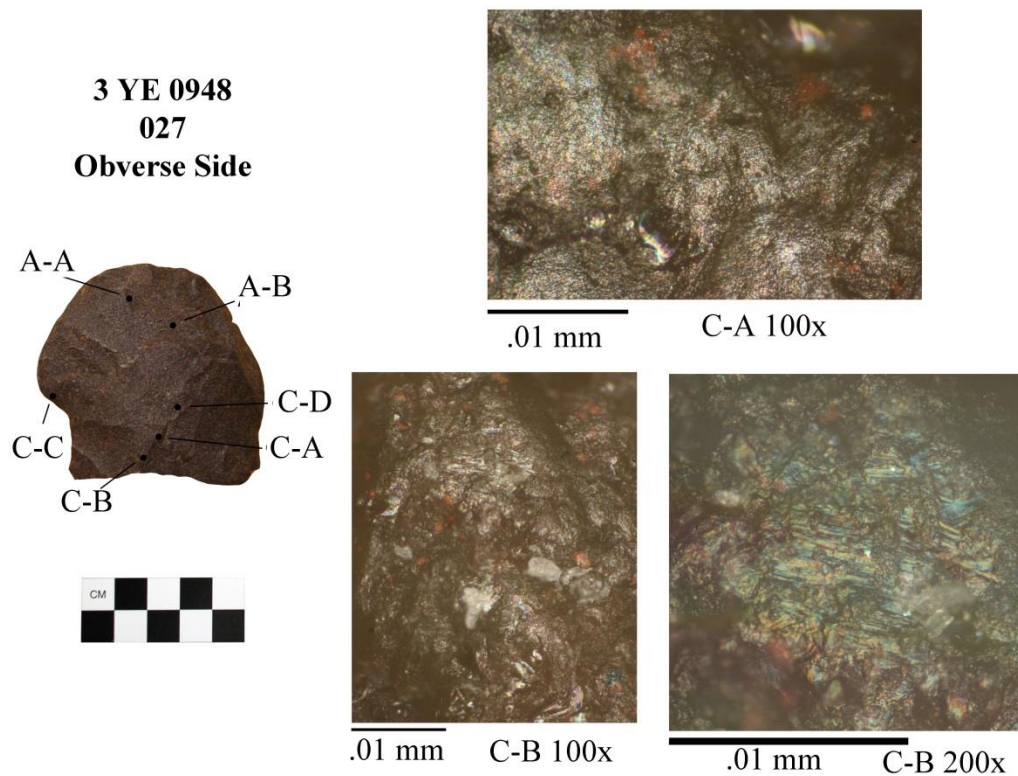


Figure 268. Hafting wear on the obverse side of Artifact 027, Location C-A and C-B, showing generalized abrasion, microplating, and light striations.

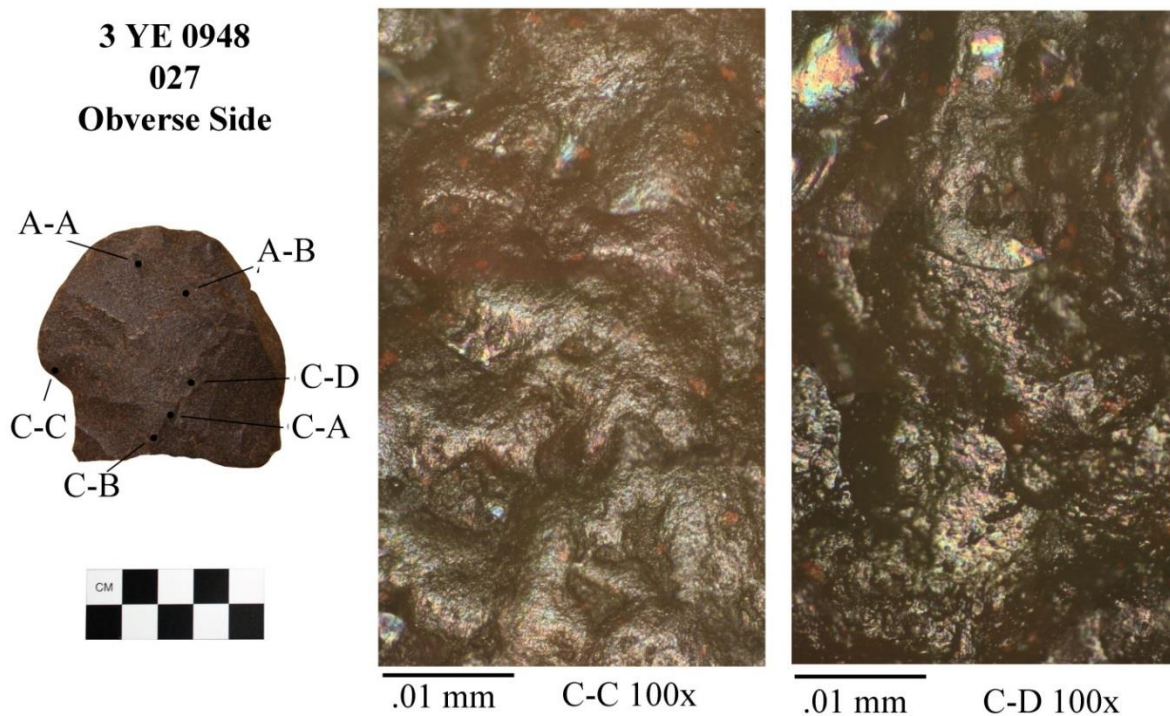


Figure 269. Hafting wear on the obverse side of Artifact 027, Locations C-C and C-D, showing microplating and generalized abrasion.

Artifact 028

Artifact 028 is half a tool made of silicified sandstone (Figure 270). The proximal side and a portion of the hafting area are intact suggesting this artifact was originally a double bitted tool. The edge on Artifact 028 has considerable rounding and the edges have some grinding. Also significant polish can be seen on both sides of the proximal edge. Once the tool failed as a tool, it was potentially modified to a wedge form tool. The broken edge of the tool has impact fractures and some grinding is present. Artifact 028 weighs 146.3 grams, with a length of 66.6mm, a width of 70.9 mm and a maximum thickness of 27.9 mm.

Casting

Only one cast was taken from Artifact 028, an obverse proximal (A) from Batch 4. This is Cast #59 and measures in at 57.5 mm in length and 37.71 mm in width (Figure 271).

Use-wear

The bit wear on this tool shows heavy microplating and portions were numerous overlapping multi-directional striations occur (Figures 271- 274).



Figure 270. The obverse and reverse sides of Artifact 028.

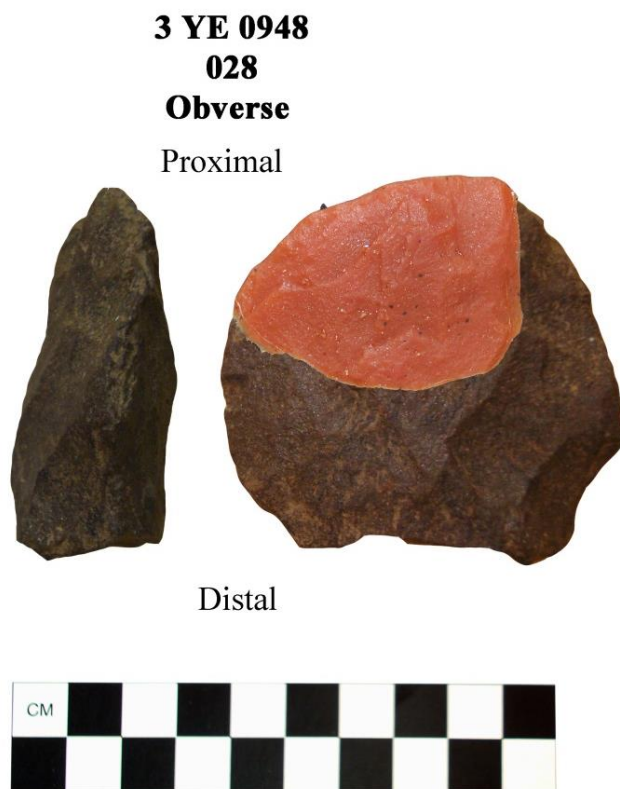
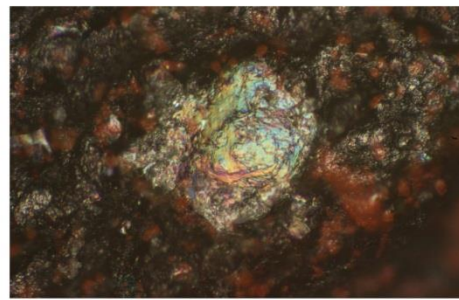
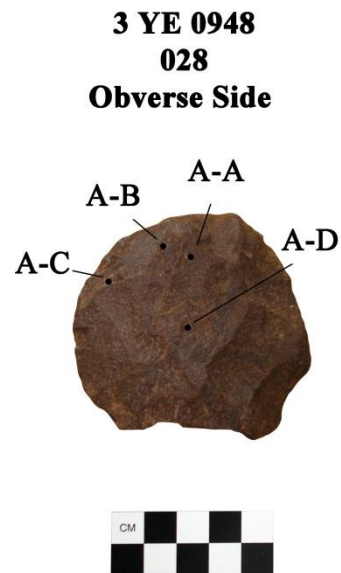
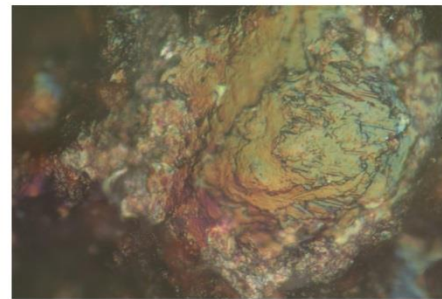


Figure 271. Casting location on the obverse side of Artifact 028.

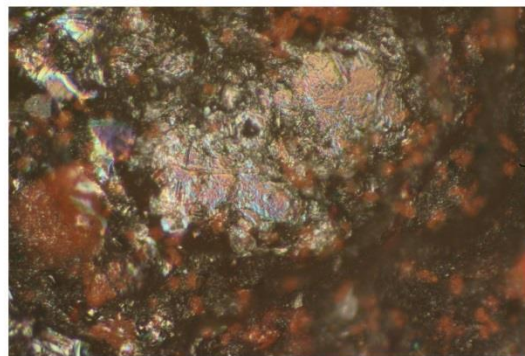
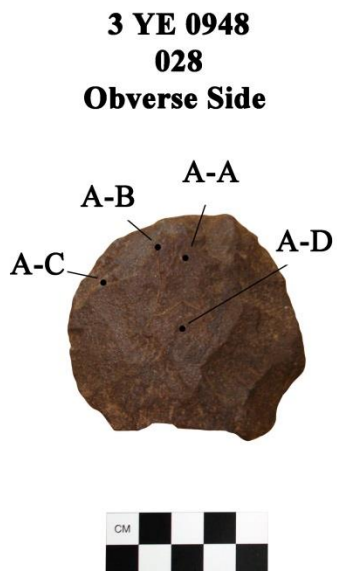


A-A 100x

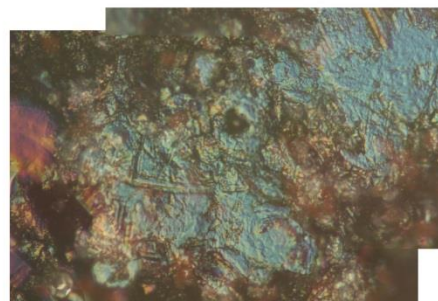


A-A 200x

Figure 272. Bit edge wear on the obverse side of Artifact 028, Location A-A, showing microplating wear.



A-B 100x



A-B 200x

Figure 273. Bit edge wear on the obverse side of Artifact 028, Location A-B, showing microplating wear and multi-directional striations.

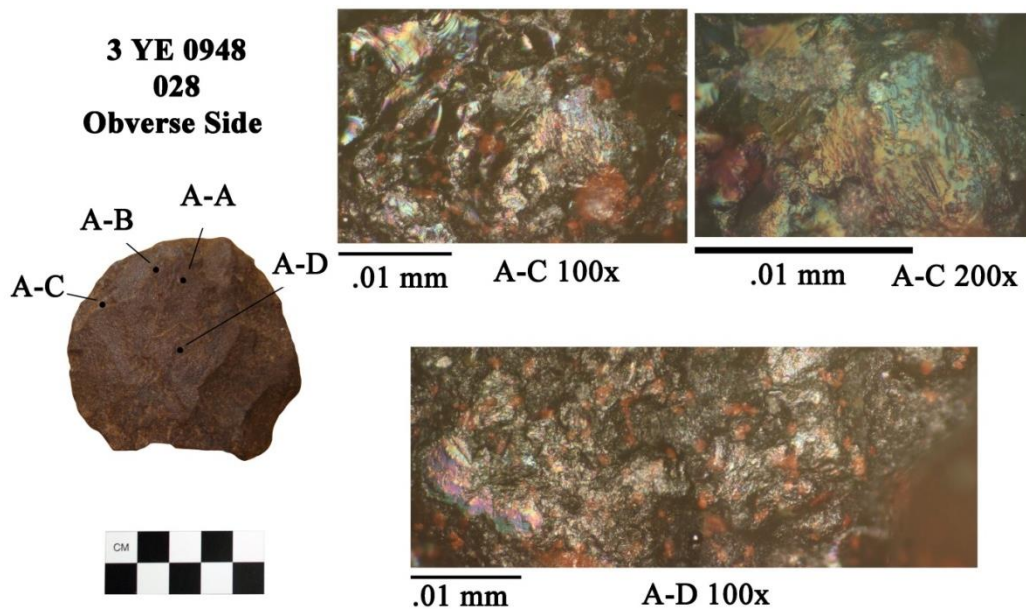


Figure 274. Bit edge wear on the obverse side of Artifact 028, Location A-C and A-D, showing microplating and few multi-directional striations.

Artifact 029

Artifact 29 is a broken piece of a double bitted tool made of silicified sandstone (Figure 275). The proximal and a small portion of the hafting area are intact. Some polish can be seen on the proximal edge. The bending fracture at the hafting portion suggests the tool was most likely damaged during use. The edges have some smoothing present and the hafting portion is well ground. Artifact 029 weighs 60.4 grams with a length of 51.6 mm, a width of 56.3 mm and a thickness of 22.7 mm.

Casting

Artifact 029 had only one mold taken from it, an obverse proximal (A) from Batch 8. This is Cast #60, and measures in at 39.6 mm in length and 44.51 mm in width (Figure 276).

Use-wear

Bit edge wear consists of microplating with some generalized abrasive wear (Figures 277-279).



Figure 275. The obverse and reverse sides of Artifact 029.



Figure 276. Casting location on the obverse side of Artifact 029.

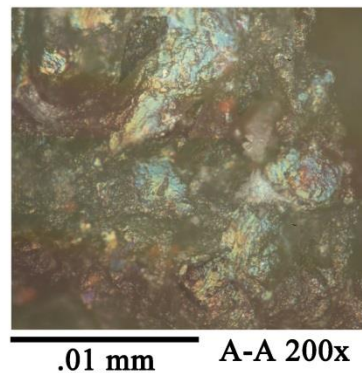
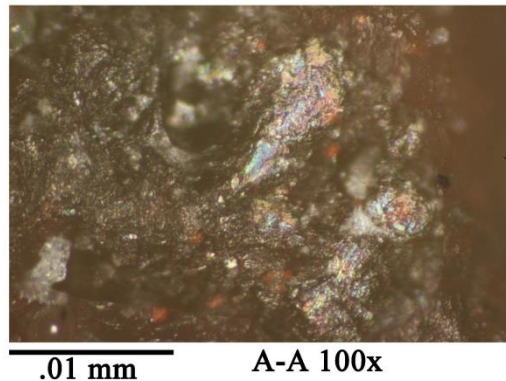
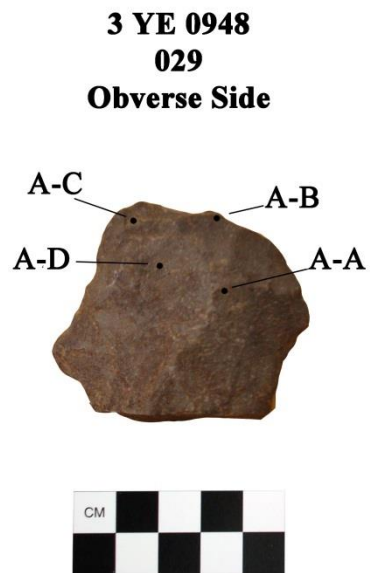


Figure 277. Bit edge wear on the obverse side of Artifact 029, Location A-A, showing microplating, generalized abrasion and light striations.

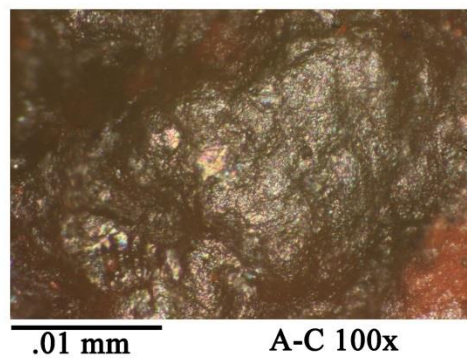
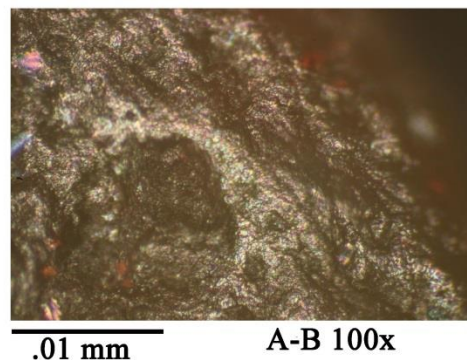
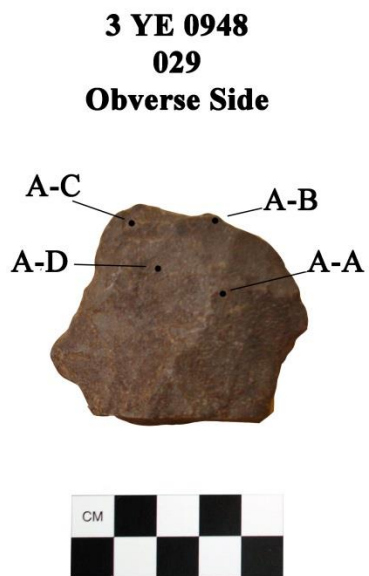


Figure 278. Bit edge wear on the obverse side of Artifact 029, Locations A-B and A-C, showing generalized abrasion and the beginnings of microplating.

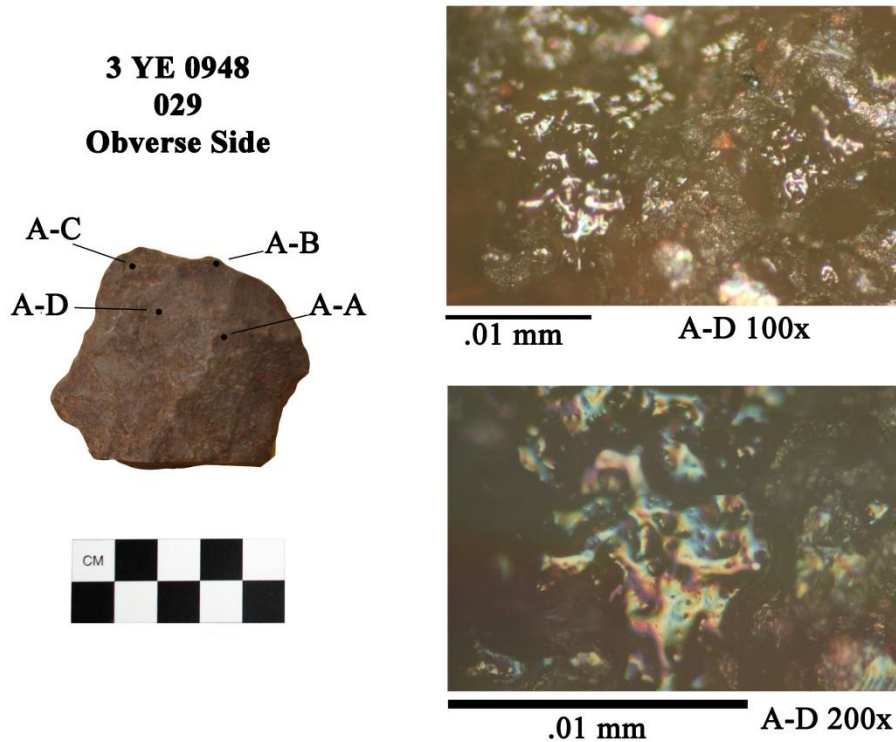


Figure 279. Casting error on the obverse side of Artifact 029, Location A-D, showing the presence of oil on the cast.

Artifact 030

Artifact 030 is a roughly hewed double bitted tool made of sandstone and is part of the practice piece or toy category (Figure 280). A portion of the lower part of the tool is missing and little wear can be seen. This tool mostly likely was damaged in the process of making and did not even make it to the tool stage. Artifact 030 is at the early stages of production, the hafting portion is clearly defined, and the edges have some smoothing and grinding present, but show little to no wear. Artifact 30 weighs 97.1 grams with a length of 89.5 mm, a width of 66.5 mm, and a maximum thickness of 17.1 mm.

Casting

Two casts were taken from Artifact 030, a proximal (D) and haft (F), both from the reverse side. Cast #61, the reverse proximal, was created out of Batch 2. The length measures

40.42 mm and the width 36.56 mm. Cast #62, the reverse haft, was casted twice due to a small hole in the original mold. The cast that held was from Batch 4 and measured 19.8 mm in length and 42.99 mm in width (Figure 281).

Use-wear

The hafting area shows microplating wear with few multi-directional striations present (Figure 282).

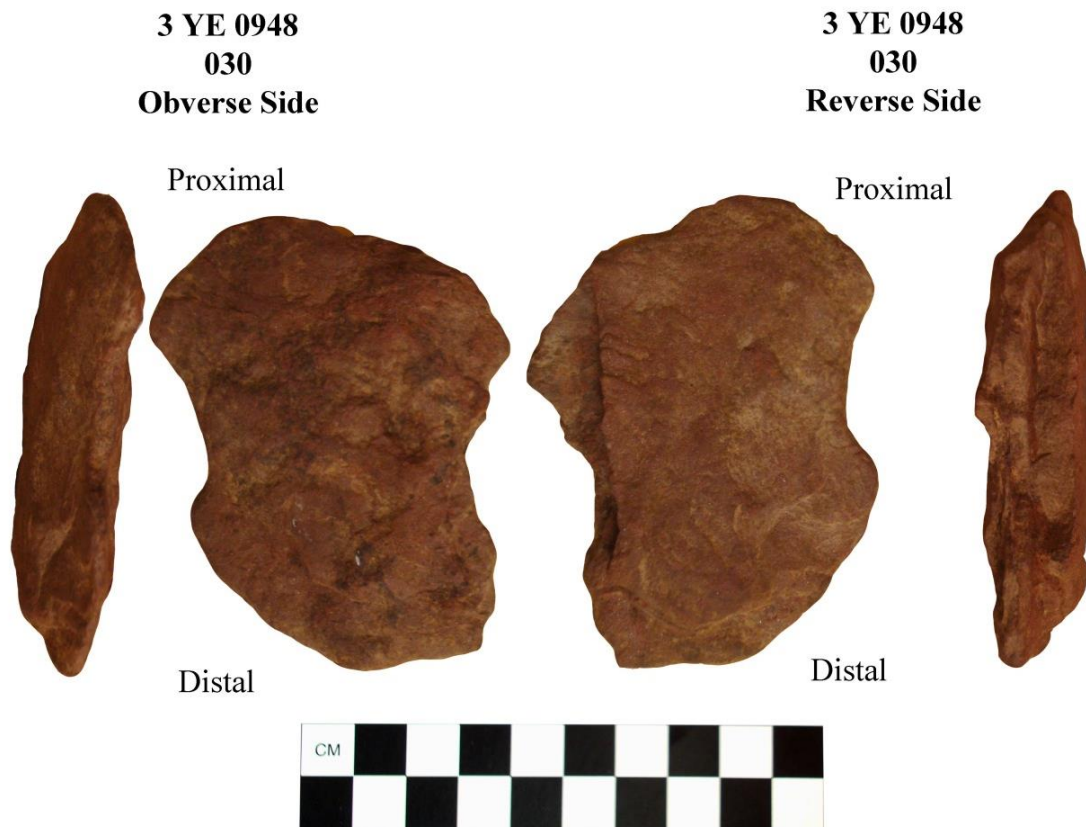


Figure 280. The obverse and reverse sides of Artifact 030.

3 YE 0948
030
Reverse Side

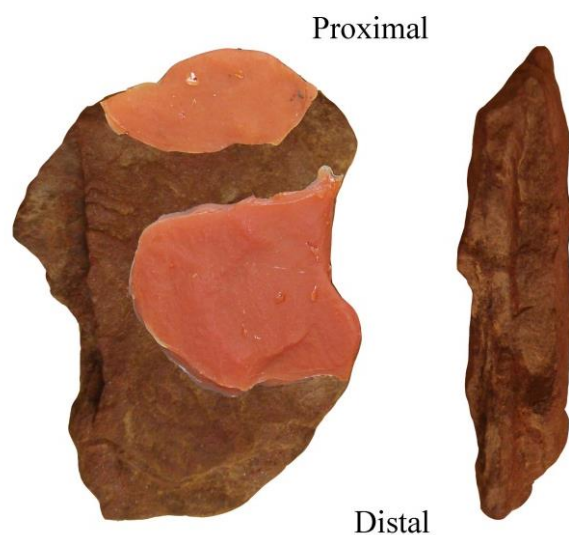


Figure 281. Casting locations on the reverse side of Artifact 030.

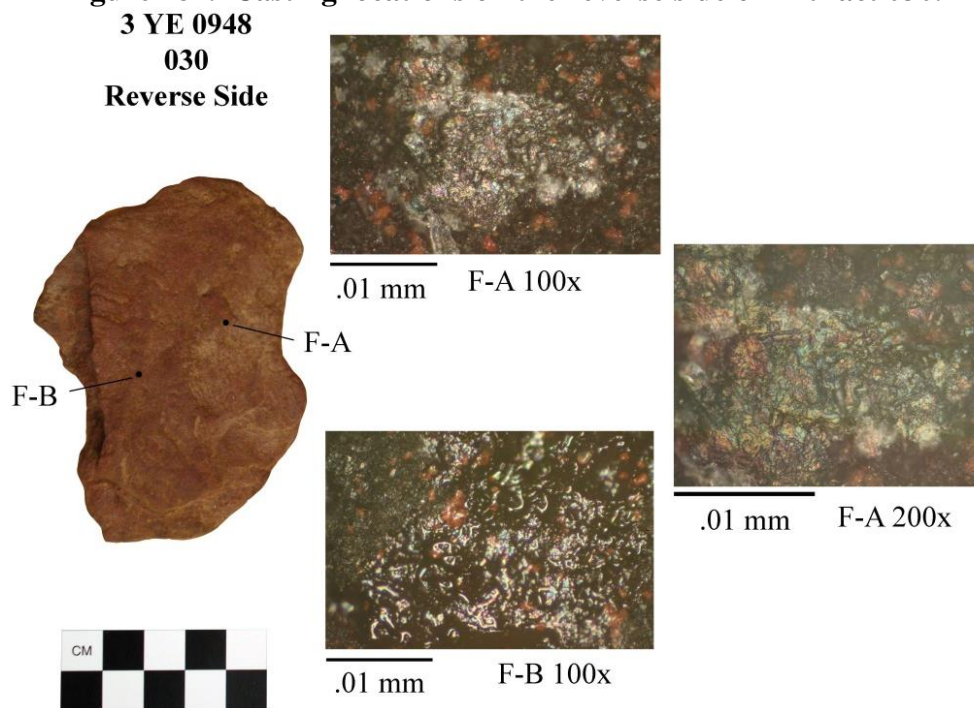


Figure 282. Hafting wear on the reverse side of Artifact 030, Locations F-A and F-B. F-A shows microplating additive wear with light multi-directional striation wear. F-B shows casting error in the form of oil.

Artifact 031

Artifact 031 is a broken piece of a tool made of silicified sandstone (Figure 283). The edges are slightly smoothed with some grinding. Some polish can be seen on the reverse side. Artifact 031 weighs 89.6 grams, with a length of 52.9 mm, a width of 62.4 mm and a maximum thickness of 22.4 mm.

Casting

Only one cast was taken from Artifact 031, a reverse proximal (D) from Batch 2. This is Cast #63 and measured in at 31.29 mm in length and 54.49 mm in width (Figure 284).

Use-wear

The bit edge showed additive microplating wear with some generalized abrasion present (Figure 285).



Figure 283. The obverse and reverse sides of Artifact 031.

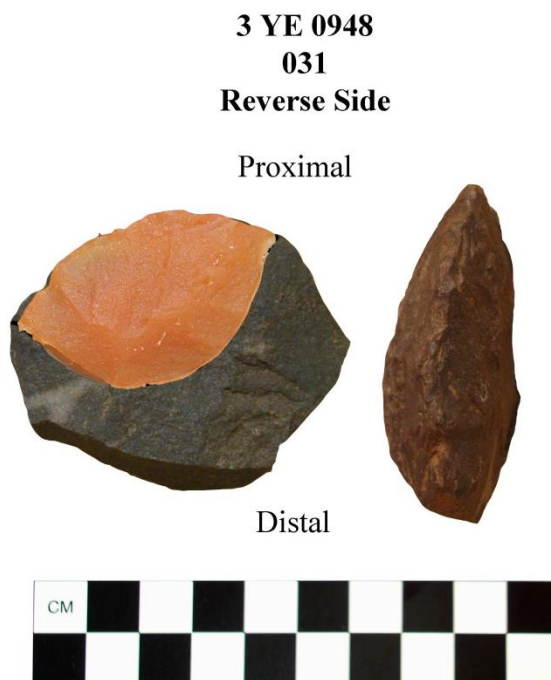


Figure 284. Casting location on the reverse side of Artifact 031.

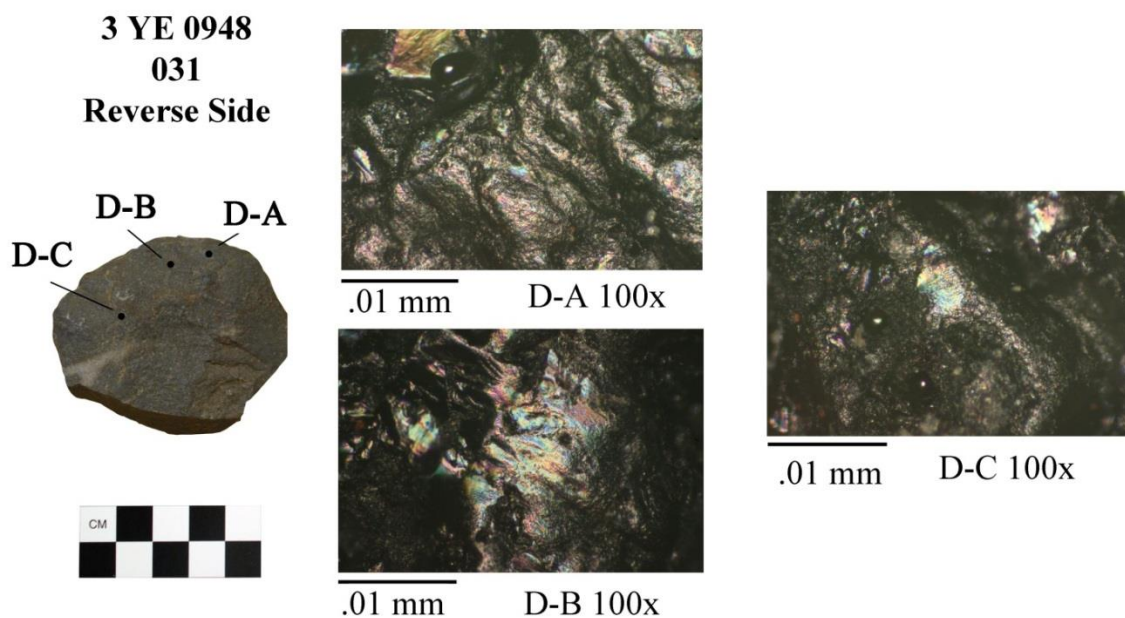


Figure 285. Bit edge wear on the reverse side of Artifact 031, Locations D-A, D-B and D-C, showing light abrasion and the beginning of microplating wear.

Artifact 032

Artifact 032 is the broken portion of a tool made of silicified sandstone (Figure 286). The tool does not show any evidence of recycling or modification; no grinding or impact from use as a hammerstone or as a wedge. The bending fracture at the hafting area suggests this tool was most likely damaged as a result of use, a twisting which occurred during impact. The obverse side has considerable polish from use. Artifact 032 weighs 45.4 grams with a length of 42.2 mm, a maximum width of 56.0 mm and a thickness of 19.7mm.

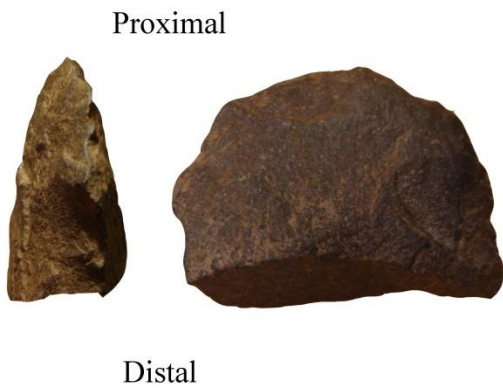
Casting

Artifact 032 had only one cast taken, an obverse proximal (A) from Batch 4. This is Cast #64 and measured in a 30.27 mm in length and 49.20 mm in width (Figure 287).

Use-wear

Bit edge wear shows large directional microplating wear which has been abraded and smoothed and runs perpendicular to the bit edge (Figures 288- 289).

**3 YE 0948
032
Obverse Side**



**3 YE 0948
032
Reverse Side**

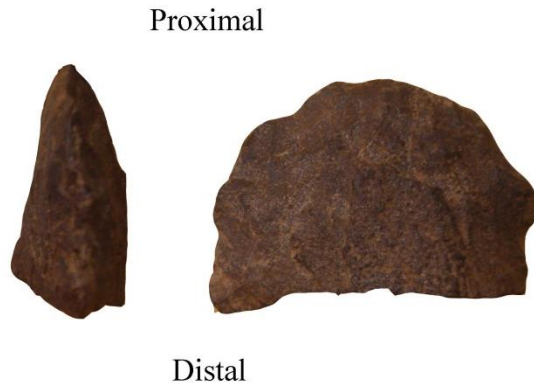


Figure 286. The obverse and reverse sides of Artifact 032.

**3 YE 0948
032
Obverse Side**

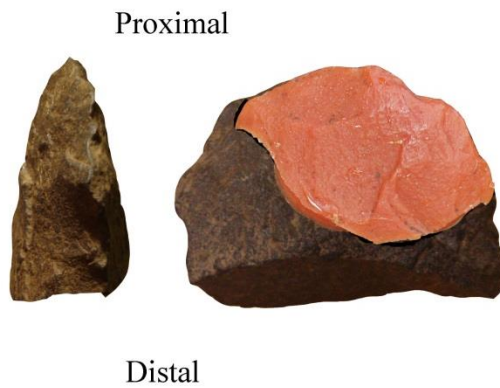


Figure 287. Casting location on the obverse side of Artifact 032.

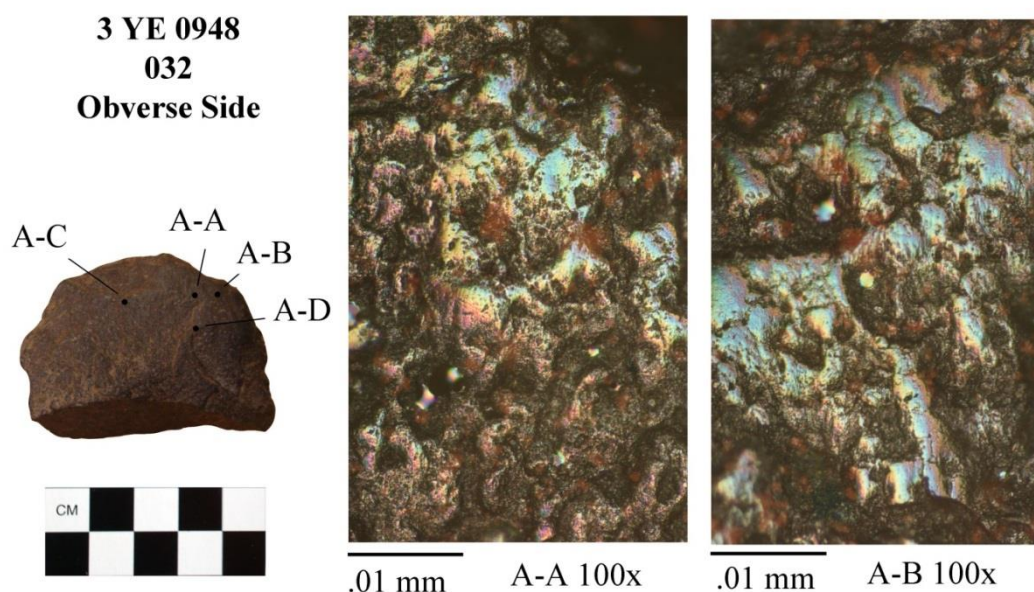


Figure 288. Bit edge wear on the obverse side of Artifact 032, Locations A-A and A-B, showing heavy directional abrasive wear.

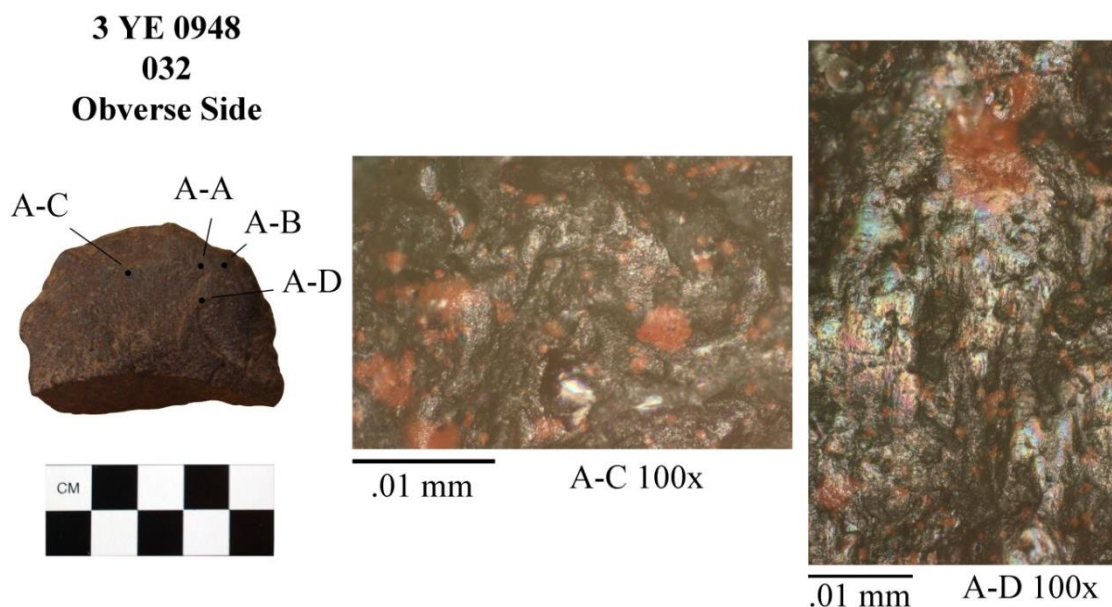


Figure 289. Bit edge wear on the obverse side of Artifact 032, Locations A-C and A-D, showing light abrasion (A-C) and directional heavy abrasion (A-D).

Artifact 033

Artifact 033 is an elongated tool made of silicified sandstone (Figure 290). This tool was potentially modified after original tool damage. The obverse side of the tool has considerable more polish on it than the reverse side. No obvious hafting wear is present. None of the edges on this tool show any macro evidence of grinding or smoothing. Artifact 033 weighs 132.2 grams, with a length of 92.4 mm, a width of 50.6mm and a thickness of 33.8 mm.

Casting

A total of three casts were taken from Artifact 033, a proximal (A), distal (B) and a haft (C), all from the obverse side. Cast # 65, the obverse proximal, was taken from Batch 9 and measures in at 30.79 mm in length and 35.68 mm in width. Cast #66, the obverse distal, was produced from Batch 11 and measures 21.04 mm in length and 35.86 mm in width. The obverse haft, Cast #67, was created from Batch 12 and measures 51.12 mm in length and 31.44 mm in width (Figure 291).

Use-wear

Wear on this tool shows generalized abrasion and microplating additive wear (Figures 292-294).

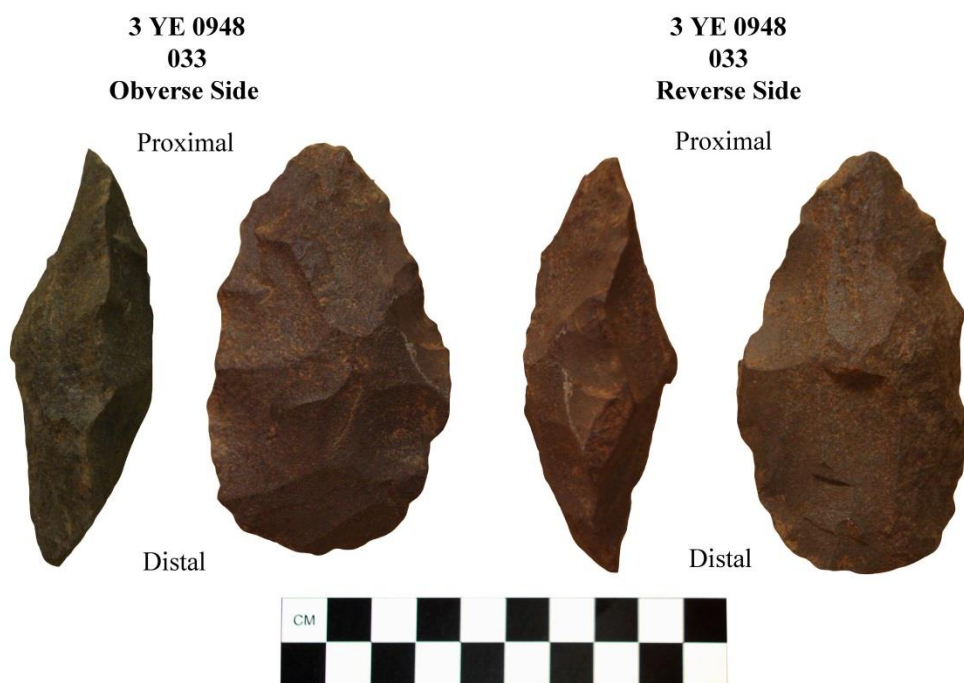


Figure 290. The obverse and reverse sides of Artifact 033.

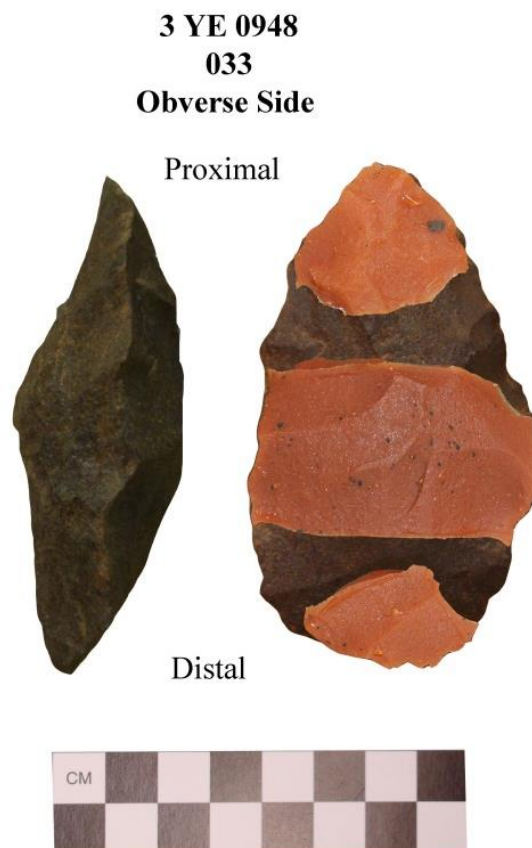


Figure 291. Casting locations on the obverse side of Artifact 033.

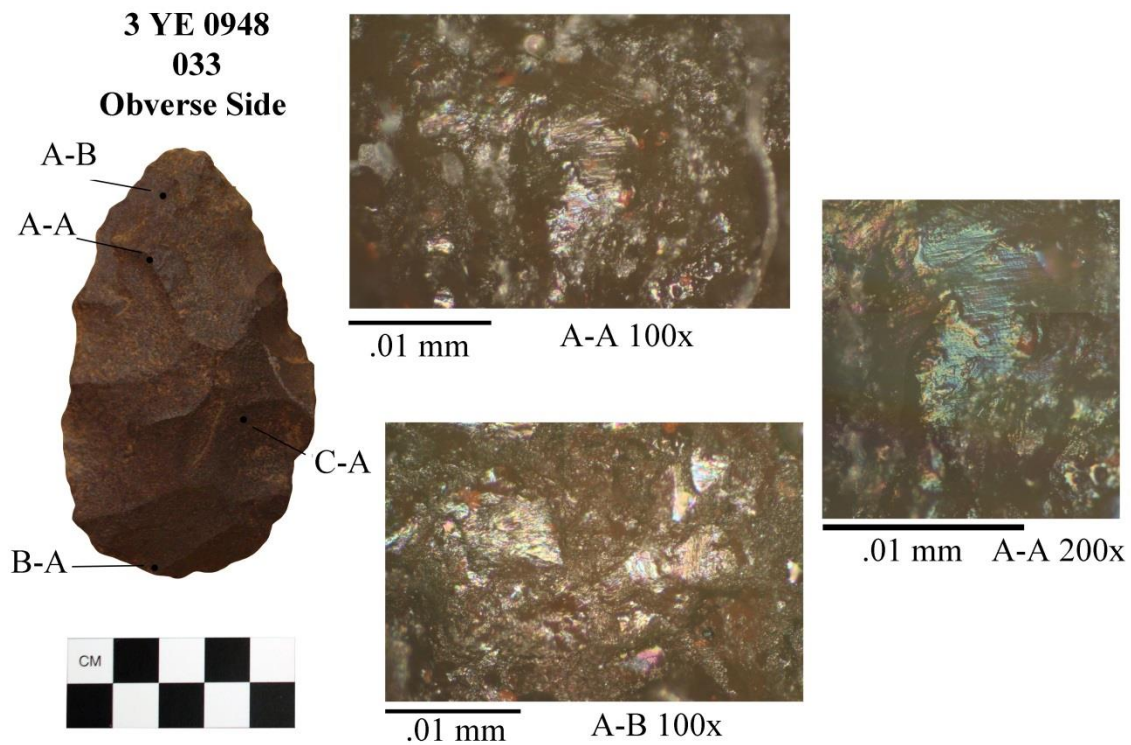


Figure 292. Bit edge wear on the obverse side of Artifact 033, Locations A-A and A-B, showing microplating wear and abrasive wear on a conchoidal fracture.

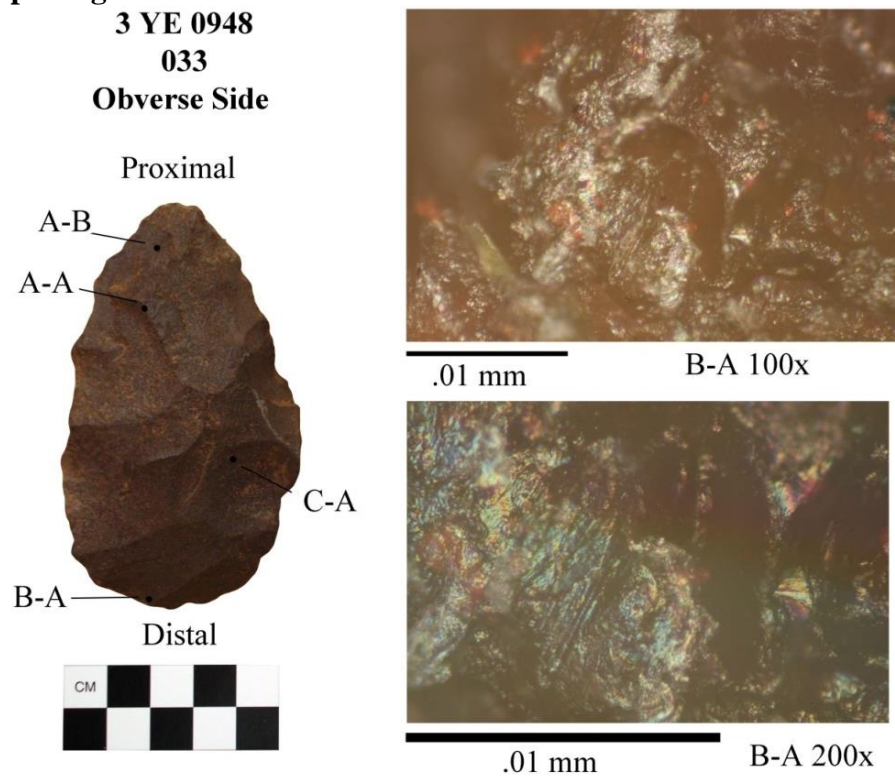


Figure 293. Bit edge wear on the obvers side of Artifact 033, Location B-A, showing microplating wear and light obliquely angled striation wear.

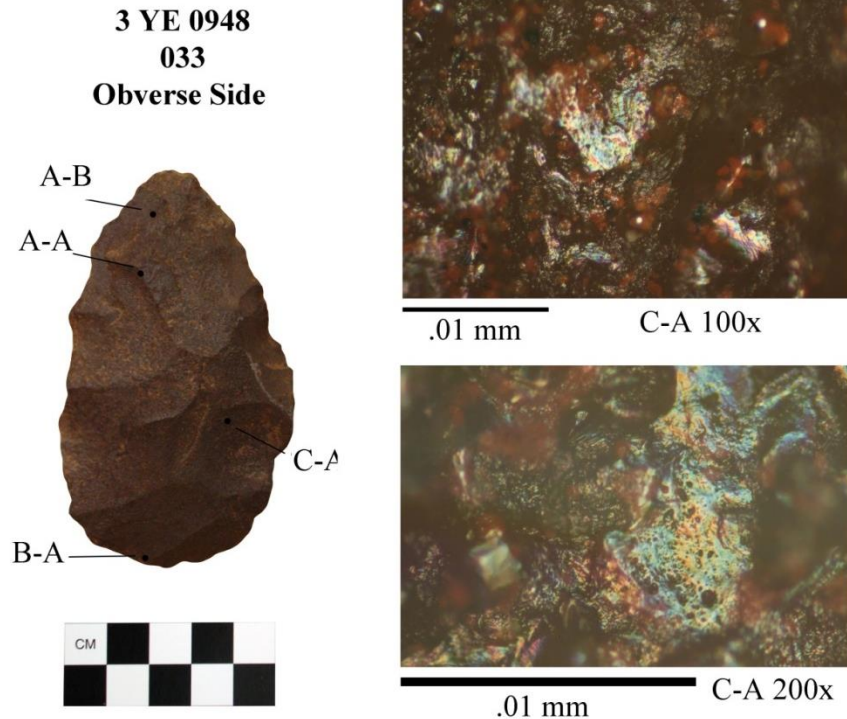


Figure 294. Casting error on the obverse side of Artifact 033, Location C-A, showing the presence of oil on the cast.

Artifact 034

Artifact 034 is a small single bitted tool made of silicified sandstone (Figure 295). Due to the tool's size and the flaking reduction, this tool appears to have been modified for continued use. Edges contain some grinding, but not extensive amounts. There is a possibility of polish which can be seen on the obverse side. Artifact 034 weighs 72.5 grams, with a maximum length of 75.6 mm, width of 51.3 mm and a maximum thickness of 24.4 mm.

Casting

Only one cast was taken from Artifact 034, a reverse proximal (D) form Batch 4. This is Cast #68 and measured in at 24.98 mm in length and 38.45 mm in width (Figure 296).

Use-wear

The wear seen consists of little microplating wear with few striations running perpendicular to the bit edge (Figure 297).



Figure 295. The obverse and reverse sides of Artifact 034.

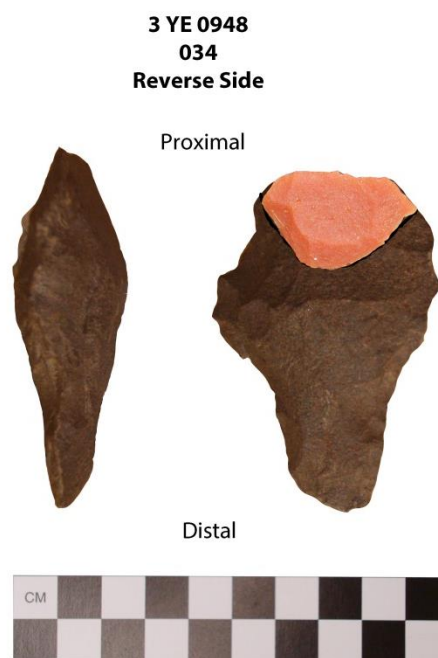


Figure 296. Casting location on Artifact 034.

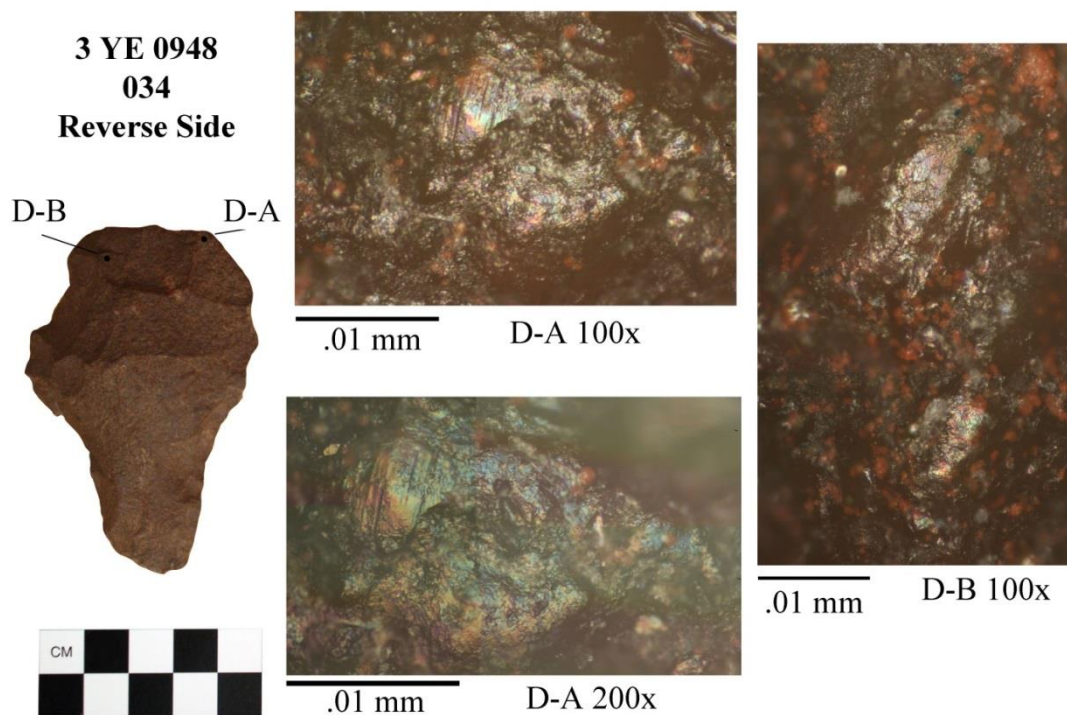


Figure 297. Bit edge wear on the reverse side of Artifact 034, Location D-A and D-B, showing generalized abrasion, microplating and light striations.

Artifact 035

Artifact 035 is a single bitted tool made of silicified sandstone with the proximal end still intact (Figure 298). The distal end of the tool, tappers to a squared off point. The proximal edge has many large flakes removed, but does not appear to have a lot of wear present. The edges are not well defined and there is no evidence of grinding or smoothing. Artifact 035 weighs 154.2 grams with a length of 89.3 mm, a width of 63.3 mm and a maximum thickness of 38.6 mm.

Casting

Two casts were taken of Artifact 035, a reverse tip and an obverse proximal. Cast #69, the reverse tip (G), measures 22.44 mm in length by 23.7 mm in length and was taken from

Batch 6. Cast # 115, the obverse proximal (a), measures 23.6 mm in length by 58.36 mm in width and was taken from Batch 13 (Figure 299).

Use-wear

The bit edge wear shows large plane-like abrasion which could be much worn microplating. Few striations can be seen running perpendicularly to the bit edge. Few locations have microplating and generalized abrasion. Hafting wear is generalized abrasion with the beginnings of microplating present (Figures 300-306).



Figure 298. The obverse and reverse sides of Artifact 035.



Figure 299. Casting locations on Artifact 035.

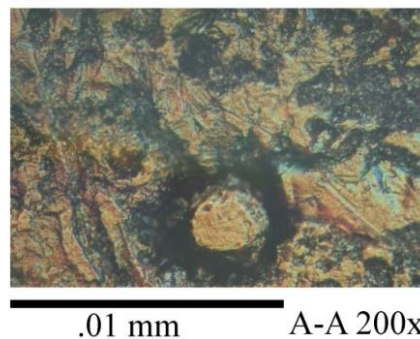
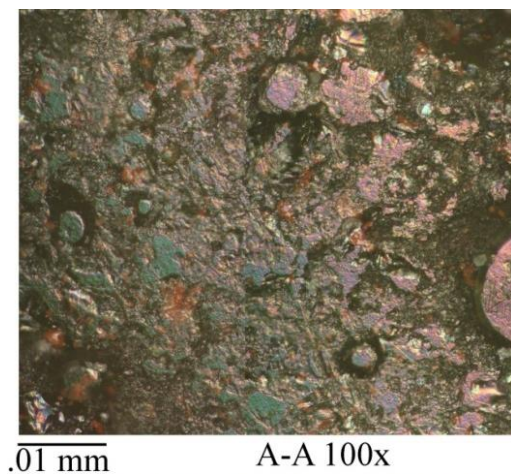
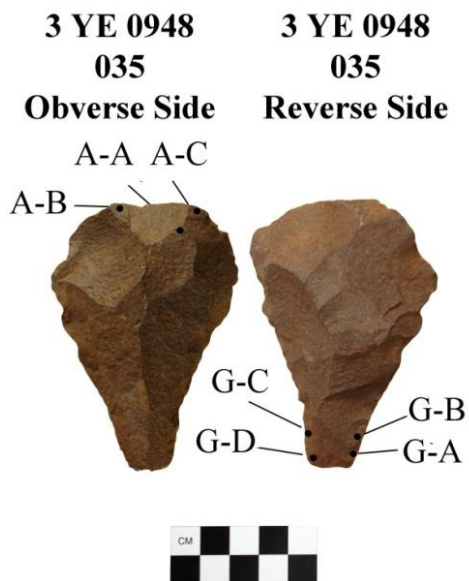


Figure 300. Bit edge wear on the obverse side of Artifact 035, Location A-A, showing large abrasive wear with light striations running perpendicular to the bit edge.

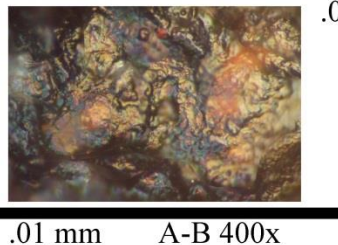
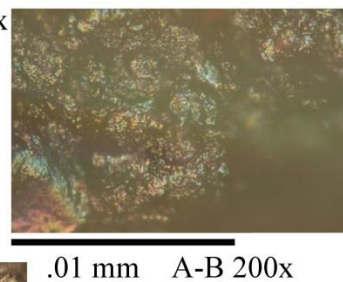
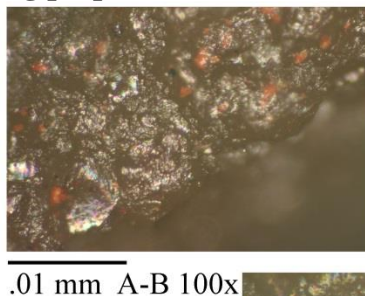
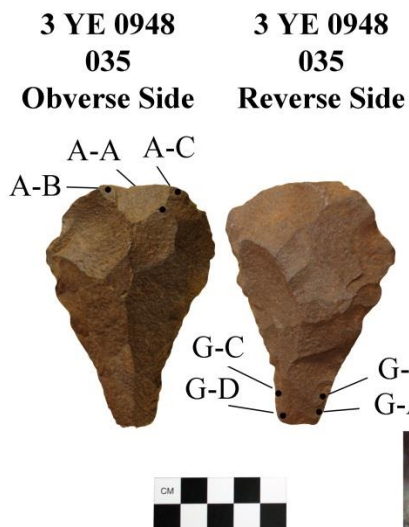


Figure 301. Bit edge wear on the obverse side of Artifact 035, Location A-B, showing generalized abrasion and the beginnings of microplating.

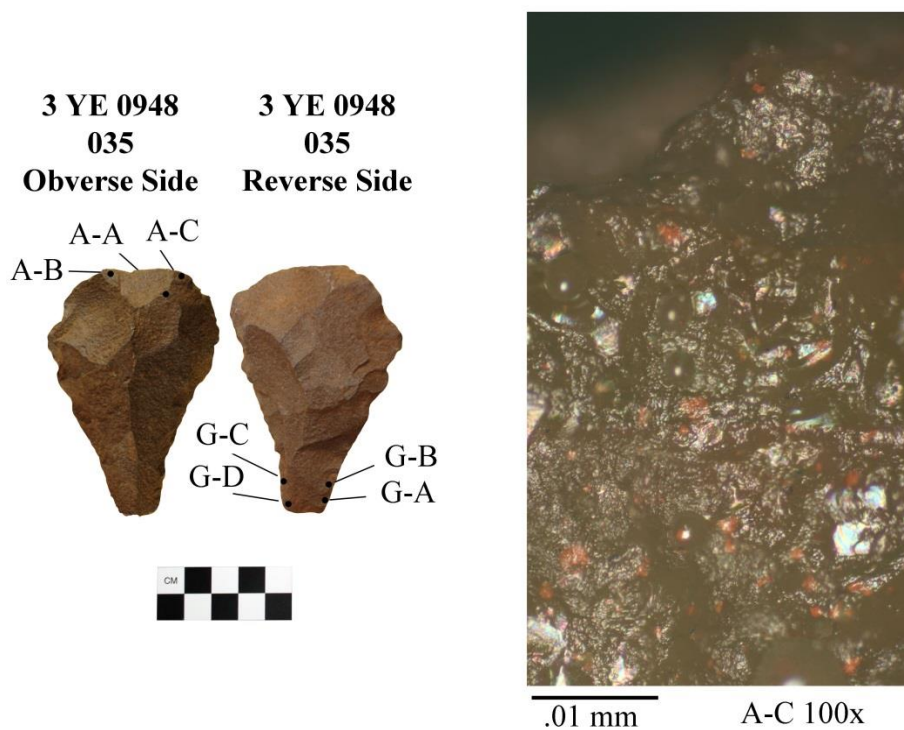


Figure 302. Bit edge wear on the obverse side of Artifact 035, Location A-C, showing generalized abrasion.

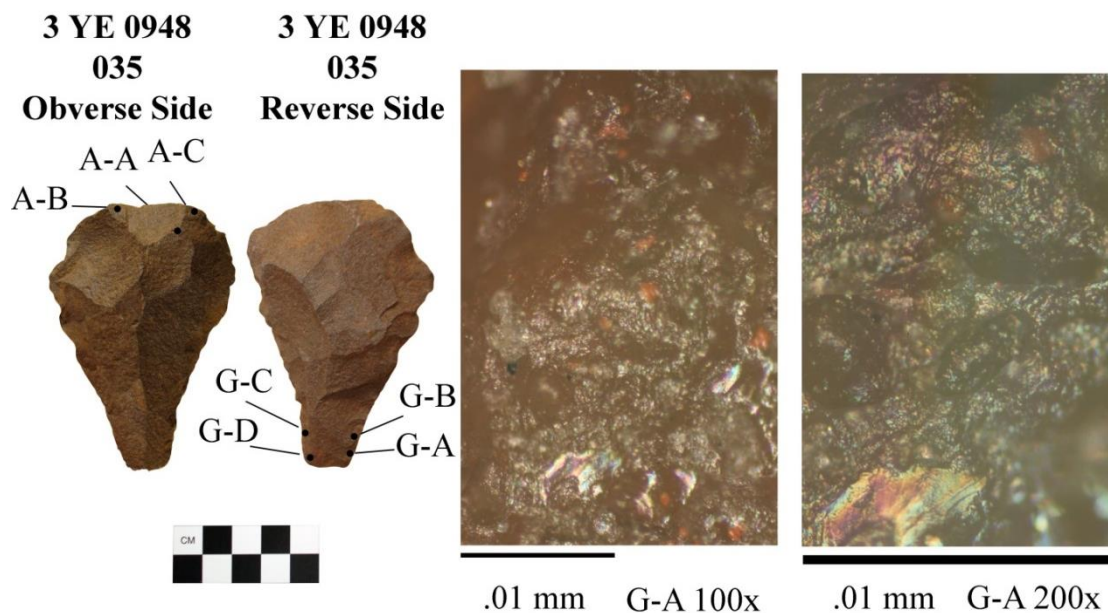
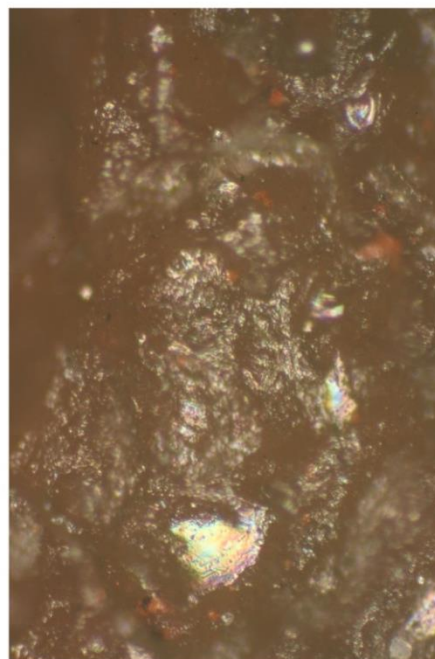
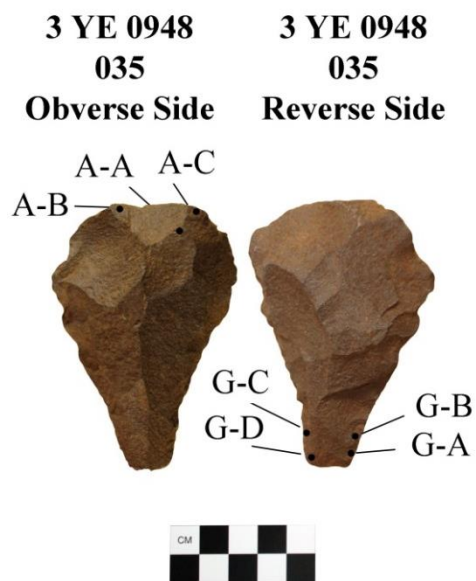


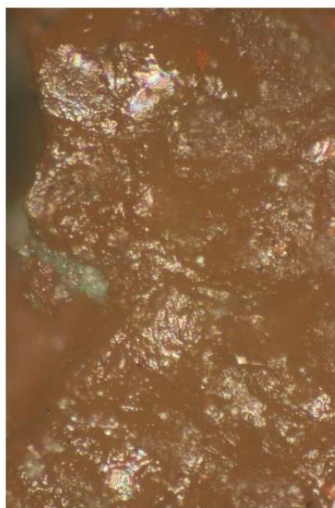
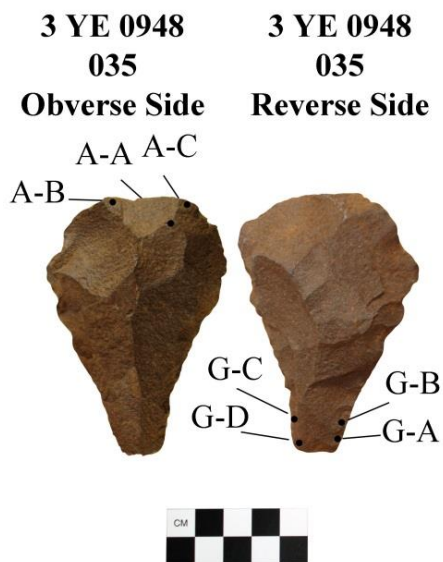
Figure 303. Hafting or tip edge wear on the reverse side of Artifact 035, Location G-A, showing generalized abrasion with the beginnings of microplating.



.01 mm

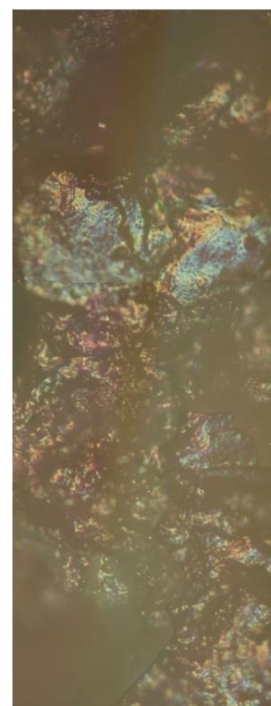
G-B 100x

Figure 304. Hafting or tip edge wear on the reverse side of Artifact 035, Location G-B, showing generalized abrasion with the beginnings of microplating.



.01 mm

G-C 100x



.01 mm G-C 200x

Figure 305. Hafting or tip edge wear on the reverse side of Artifact 035, Location G-C, showing generalized abrasion with the beginnings of microplating.

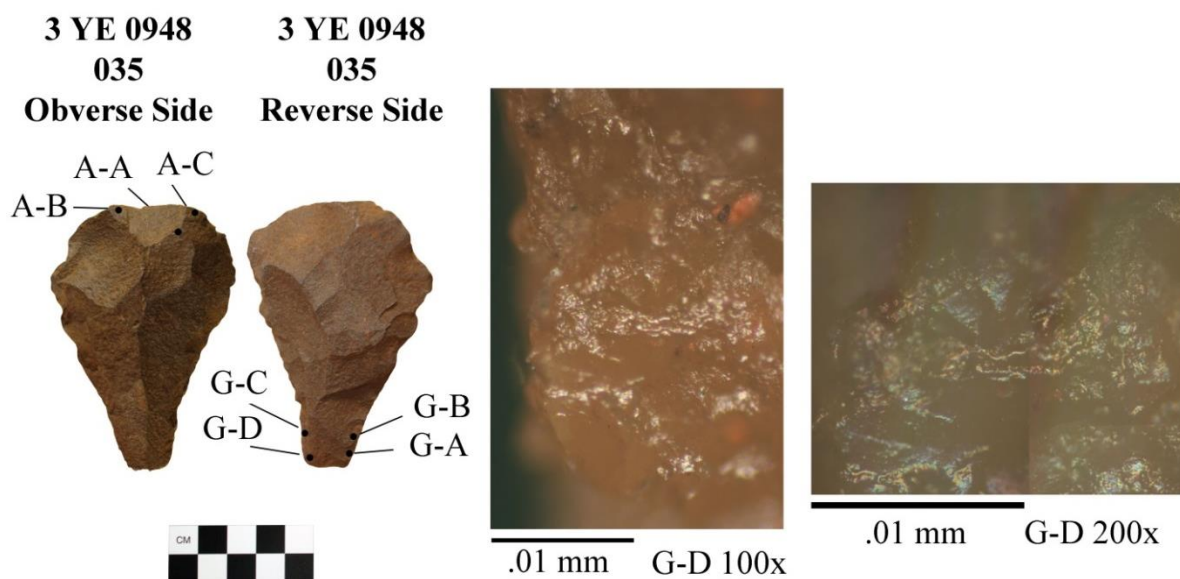


Figure 306. Hafting or tip edge wear on the reverse side of Artifact 035, Location G-D, showing generalized abrasion with the beginnings of microplating.

Artifact 036

Artifact 036 is a fragmented portion of silicified sandstone tool (Figure 307). The edges do not have considerable smoothing or grinding and the broken edge of the tool does not show impact or smoothing from use as a wedge or hammerstone. There does not appear to be significant use wear present, and no visible polish. The presence of the bending fracture on this tool suggests damaged occurred during use. Artifact 036 weighs 71.9 grams, and is 46.2 mm in length, 74.8 mm in width, and 17.2 mm in thickness.

Casting

Only one cast was taken from Artifact 036, a reverse proximal (D) from Batch 5. This is Cast #70 and measured in at 26.5 mm in length by 51.8 mm in length (Figure 308).

Use-wear

Artifact 036 provides unique use-wear not seen on much of the rest of the collection. Portions of this tool show significant smoothing, with long striations running obliquely

perpendicular to the tool edge. These striations are overlapping and multi-directional with some partially filled in. Other locations on the tool show microflaking with generalized abrasion and long striations which give the appearance of scraping (Figures 309- 311).



Figure 307. The obverse and reverse sides of Artifact 036.

3 YE 0948
036
Reverse Side

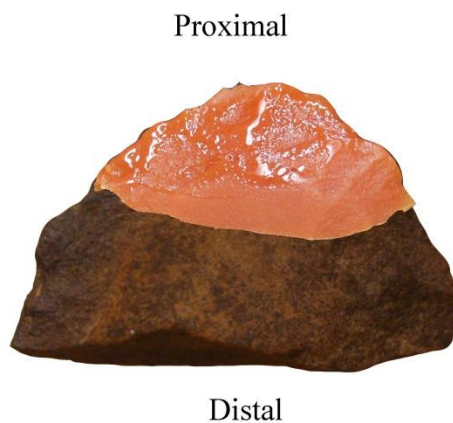


Figure 308. Casting location on the reverse side of Artifact 036.

3 YE 0948
036
Reverse Side

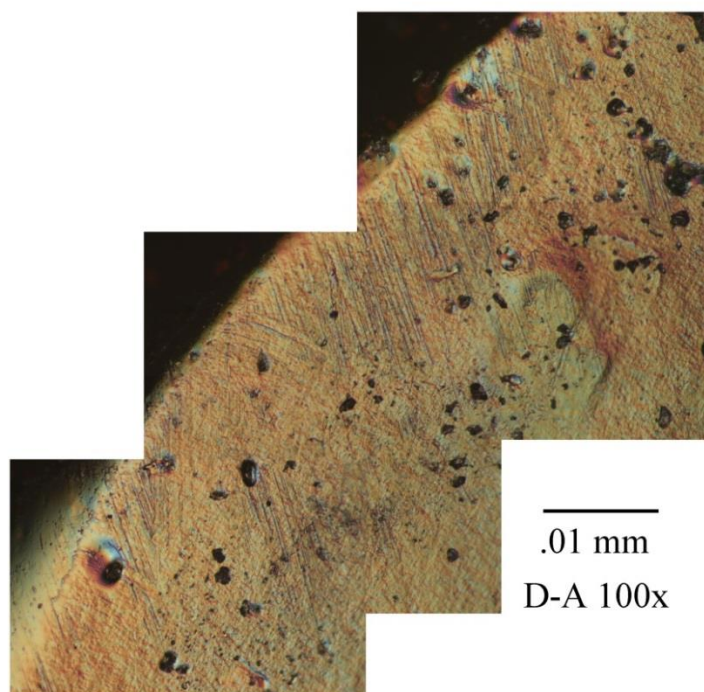
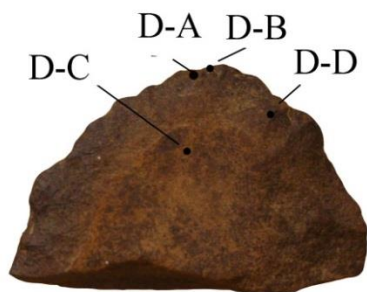


Figure 309. Bit edge wear on the reverse side of Artifact 036, Location D-A, showing extreme abrasion with numerous multi-directional striations.

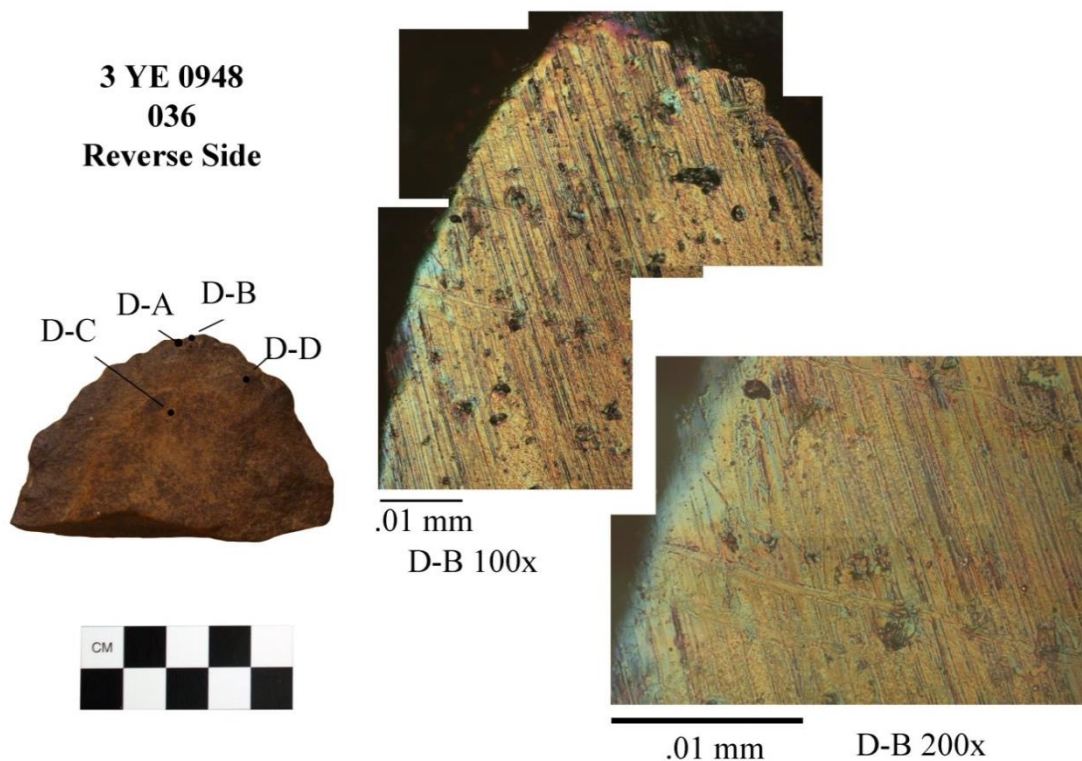


Figure 310. Bit edge wear on the reverse side of Artifact 036, Location D-B, showing substantial abrasive wear and numerous multi-directional striations.

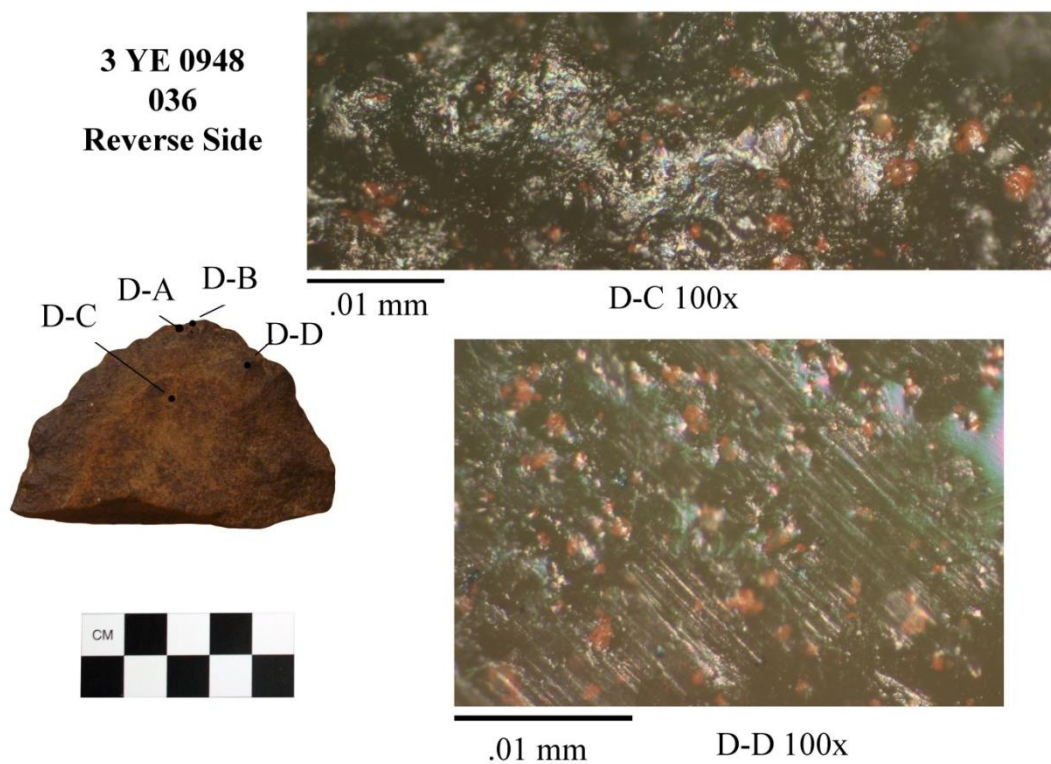


Figure 311. Bit edge wear on the reverse side of Artifact 036, location D-C and D-D, showing abrasive and additive wear and directional striations.

Artifact 037

Artifact 037 is a broken half of a double bitted tool, with the hafting portion still intact (Figure 312). Made of silicified sandstone, it looks as though many large flakes were removed, possibly for the improvement of the tool, prior to the tool breaking. The bending fracture seen at what is left of the hafting edge, suggests this tool was damaged during use. The obverse side has a large step fracture, perhaps the reason for the removal of flakes. This tool does not appear to have been modified or recycled into another tool form. There is no evidence of impact or smoothing on the broken edge of the tool. Artifact 037 weighs 85.1 grams with a length of 58.5 mm, a width of 53.6 mm and a thickness of 21.9 mm.

Casting

Artifact 037 had only one cast taken from the obverse proximal (D) created from Batch 9. This is cast # 71 and it measures in at 27.4 mm in length and 39.24 mm in width (Figure 313).

Use-wear

The wear seen on this tool consists of generalized abrasion throughout with the beginnings of microplating additive wear (Figures 314-315).



Figure 312. The obverse and reverse sides of Artifact 037.

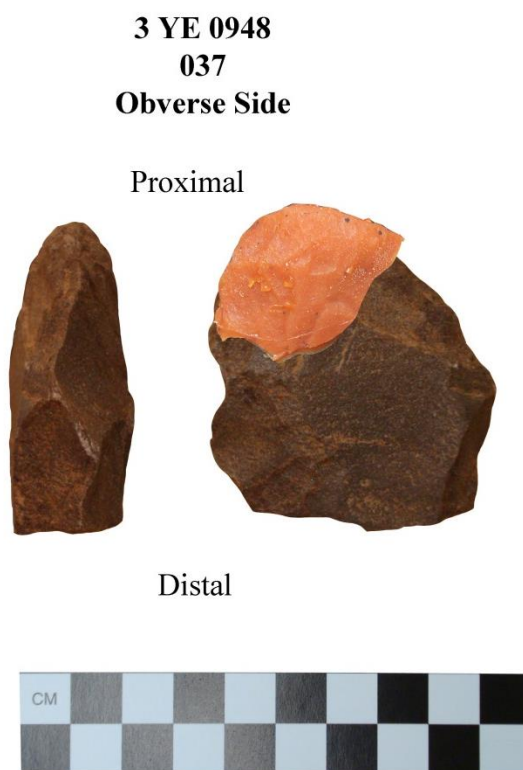


Figure 313. Casting location on the obverse side of Artifact 037.

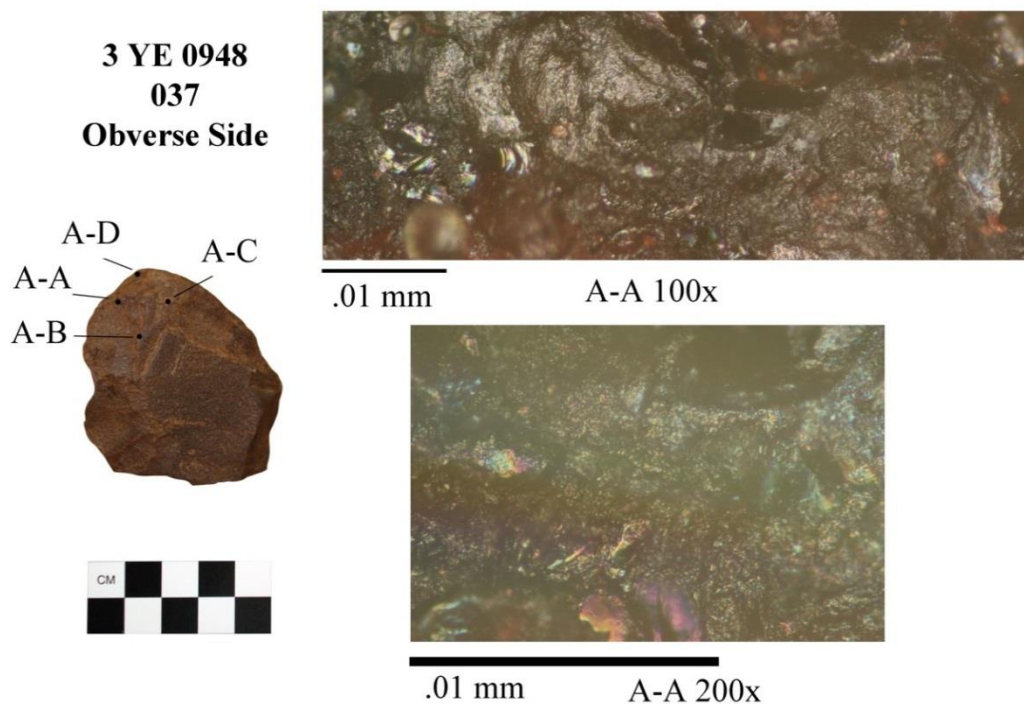


Figure 314. Bit edge wear on the obverse side of Artifact 037, Location A-A, showing light abrasion and the beginnings of microplating.

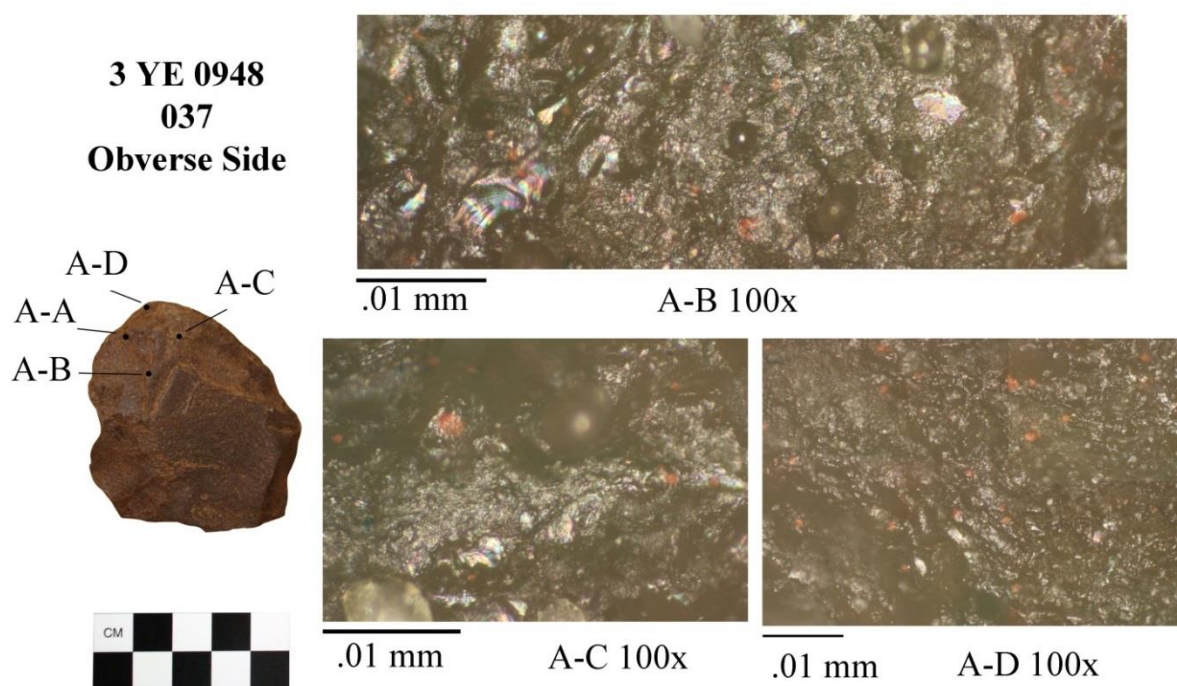


Figure 315. Bit edge wear on the obverse side of Artifact 037, Location A-B, A-C and A-D, showing generalized abrasion and the beginnings of microplating.

Artifact 038

Artifact 038 is a fragment of a tool made of silicified sandstone (Figure 316). The tool was most likely damaged during use, though a twisting at impact. The tool does not appear to have been modified or recycled as there is no evidence of impact or grinding on the damaged end. Artifact 038 weighs 54.5 grams, with a length of 36.7 mm, a width of 56.0 mm and a thickness of 23.3 mm.

Casting

Only one cast was taken from Artifact 038, a reverse proximal (D) created from Batch10. This is Cast #72 and it measures in at 30.18 mm in length and 43.62 mm in width (Figure 317).

Use-wear

The bit edge wear seen consists of places of heavy microplating wear with partially filled in striations. Generalized abrasion can be seen throughout the tool (Figures 318-319).



Figure 316. The obverse and reverse sides of Artifact 038.

3 YE 0948
038
Reverse Side

Proximal

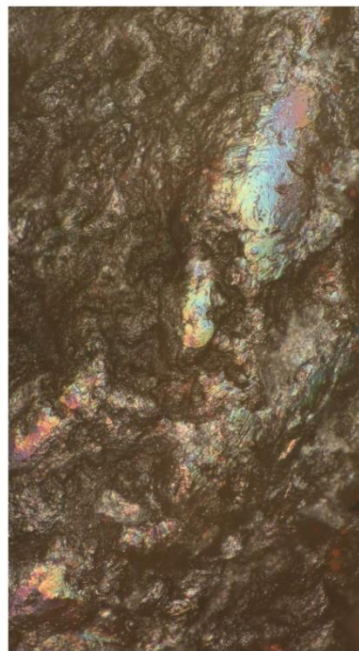
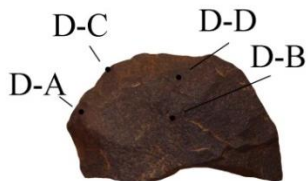


Distal



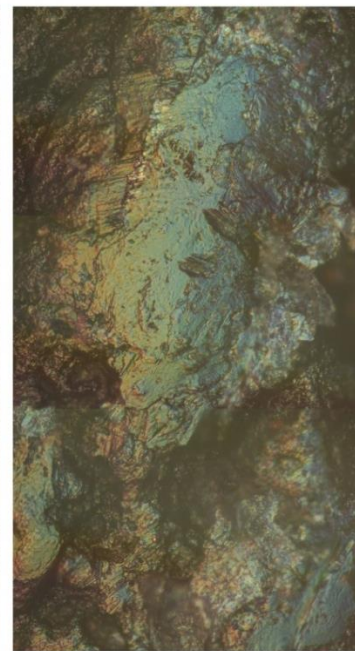
Figure 317. Casting location on the reverse side of Artifact 038.

3 YE 0948
038
Reverse Side



.01 mm

D-A 100x



.01 mm

D-A 200x

Figure 318. Bit edge wear on the reverse side of Artifact 038, Location D-A, showing large microplating plans with multi-directional striations both newly formed and in the process of being filled in.

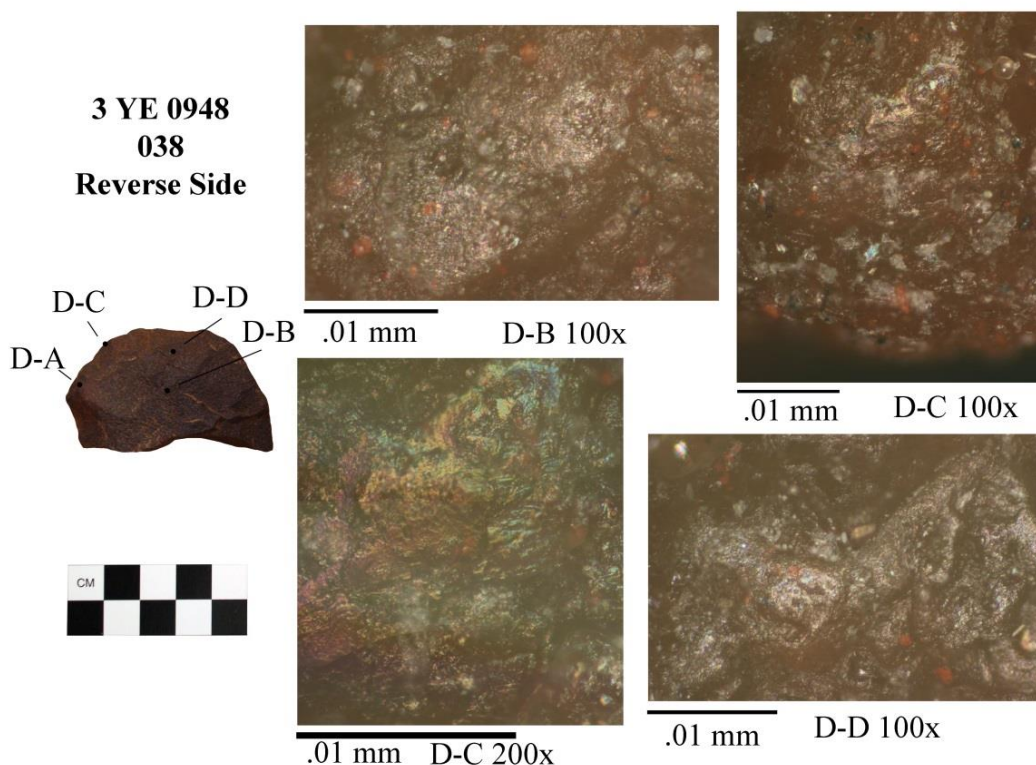


Figure 319. Bit edge wear on the reverse side of Artifact 038, Locations D-B, D-C and D-D, showing abrasive and microplating wear.

Artifact 039

Artifact 039 is a damaged portion of a single bitted tool made of silicified sandstone (Figure 320). The edge is rounded and modified with some grinding and smoothing. The tool does not appear to have been recycled as there is no evidence of impact or grinding on the broken edge of the tool for use as a wedge or hammerstone. Artifact 039 weighs in at 34.3 grams, with a length of 50.9 mm, a width of 45.0 mm and a thickness of 13.8 mm.

Casting

Artifact 039 had only one cast taken, an obverse proximal (A) created from Batch 4. This is Cast #73 and it measures in at 31.3 mm in length and 43.71 mm in width (Figure 321).

Use-wear

The bit edge wear consists of abrasive wear with the beginnings of microplating (Figures 322-323).



Figure 320. The obverse and reverse sides of Artifact 039.

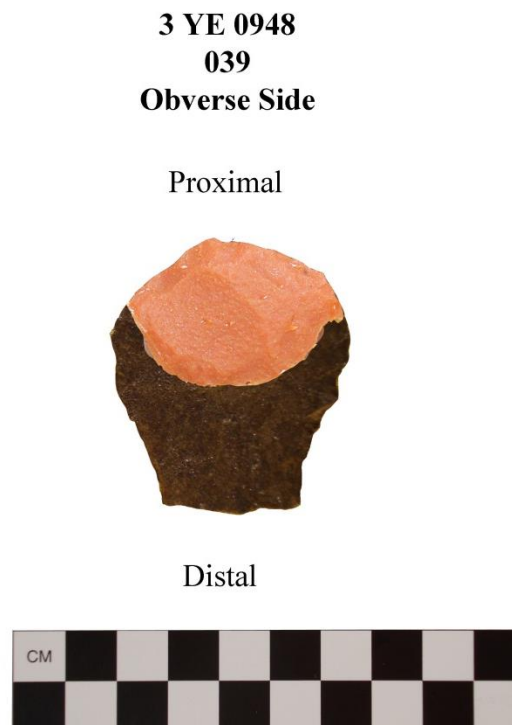


Figure 321. Casting location on the obverse side of Artifact 039.

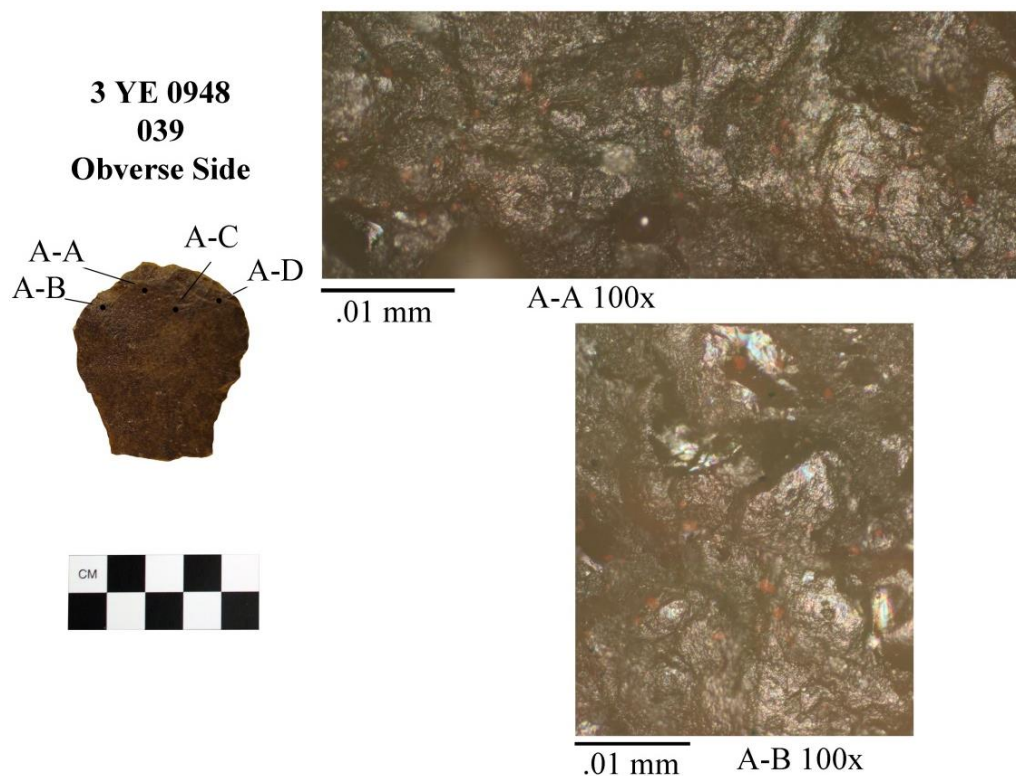


Figure 322. Bit edge wear on the obverse side of Artifact 039, Location A-A and A-B, showing generalized abrasion and the beginnings of microplating.

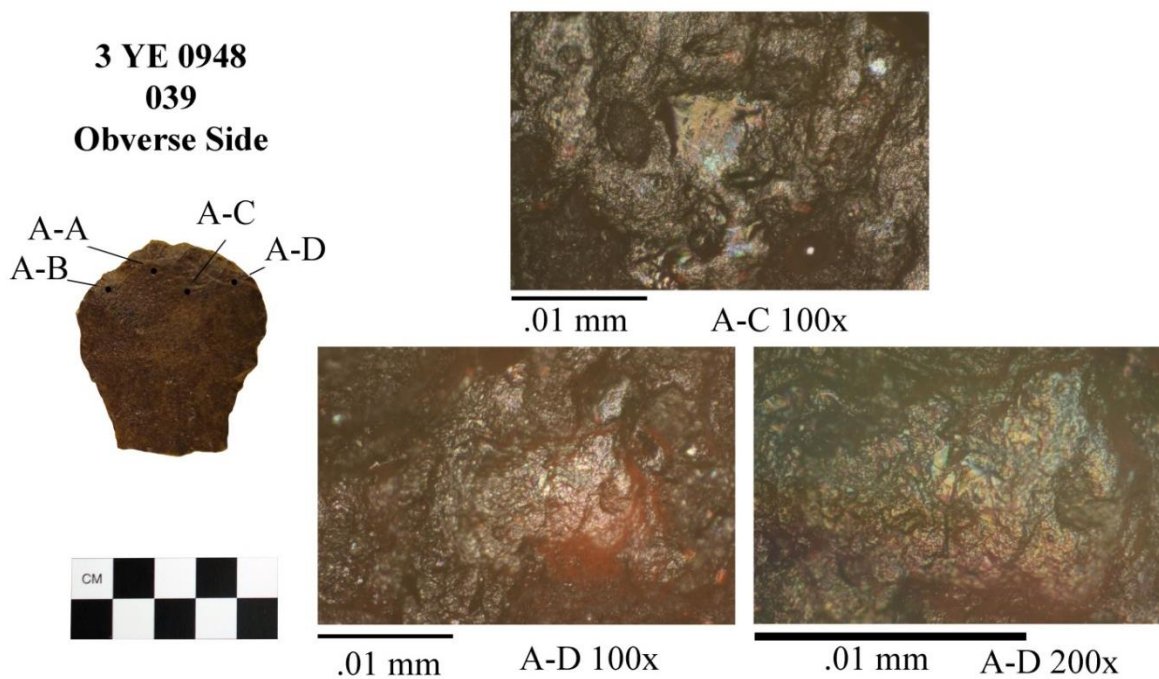


Figure 323. Bit edge wear on the obverse side of Artifact 039, Locations A-C and A-D, showing additive and abrasive wear.

Artifact 040

Artifact 040 is a unique tool in the collection (Figure 324). This tool is a distal end of a grooved tool. It is made from basalt and is the only tool in the collection which has these characteristics or is made of this material. Striations and use wear can be seen with the naked eye. There is potential evidence for the grooved haft present, however, this tool is so heavily damaged that guaranteed identification is difficult. Artifact 040 weighs 93.6 grams with a length of 67.0 mm, a maximum width of 51.4 mm and a thickness of 23.8 mm.

Casting

Only one cast was taken from Artifact 040, an obverse proximal (A) created from Batch 4. This is cast #74 and is 31.3mm in length and 43.71 mm in width (Figure 325).

Use-wear

Since this tool is made from slate as opposed to the silicified sandstone, the use-wear on it is substantially different from what is seen on the rest of the collection. The wear seen is simple generalized abrasion with very light, small locations of potential microplating wear (Figure 326).

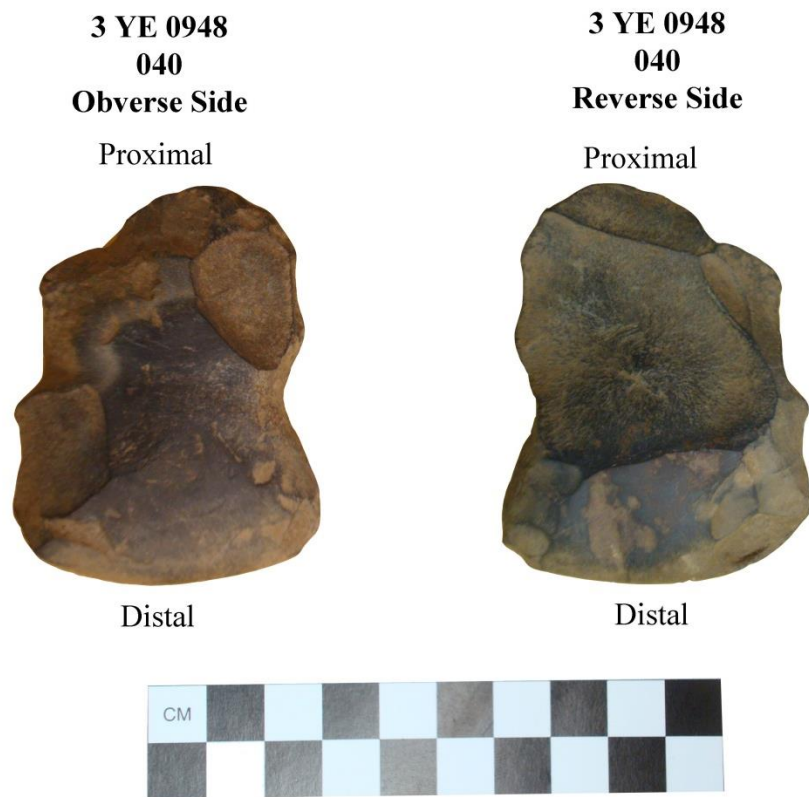


Figure 324. The obverse and reverse sides of Artifact 040.

3 YE 0948
040
Obverse Side

Proximal

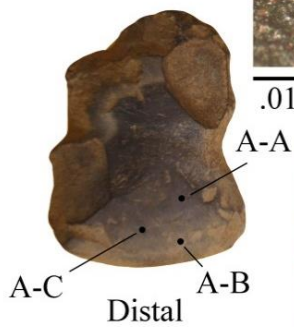


Distal

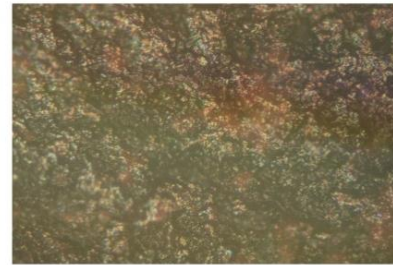


Figure 325. Casting Location on Artifact 040.

3 YE 0948
040
Obverse Side
Proximal



.01 mm A-A 100x



.01 mm A-A 200x



.01 mm A-B 100x



.01 mm A-C 100x

Figure 326. Generalized abrasive wear on the hafting area on the obverse side of Artifact 040.

Artifact 041

Artifact 041 is an elongated tool form with no concave hafting portion and is quite thick (Figure 327). The reverse side is fairly flat, while the obverse side has considerable elevation. There is no evidence on any of the tool edges that suggest grinding or smoothing. Also, there is no obvious macro evidence of wear or polish. Artifact 041 weighs 110.1 grams, with a length of 96.0 mm, a width of 47.9 mm and a maximum thickness of 28.5 mm

Casting

A total of three casts were taken from Artifact 041, a proximal (D), a distal (E) and a haft (F), all taken from the reverse side. Cast #75, the reverse proximal, was taken from Batch #10 and measures in at 22.93 mm in length and 31.14 mm in width. The reverse distal cast, Cast #76, was taken from Batch 10 and measures in at 23.04 mm in length and 26.11 mm in width. Cast #77, the reverse haft, was taken from Batch 9 and measured 47.45 mm in length and 33.85 mm in width (Figure 328).

Use-wear

Bit edge wear consists of generalized abrasion on the proximal edge and heavy microplating with multi-directional striations on the distal edge. The wear seen in the hafting portion is fairly generalized abrasive wear, but with little microplating occurring and some multi-directional striations (Figures 329-332).

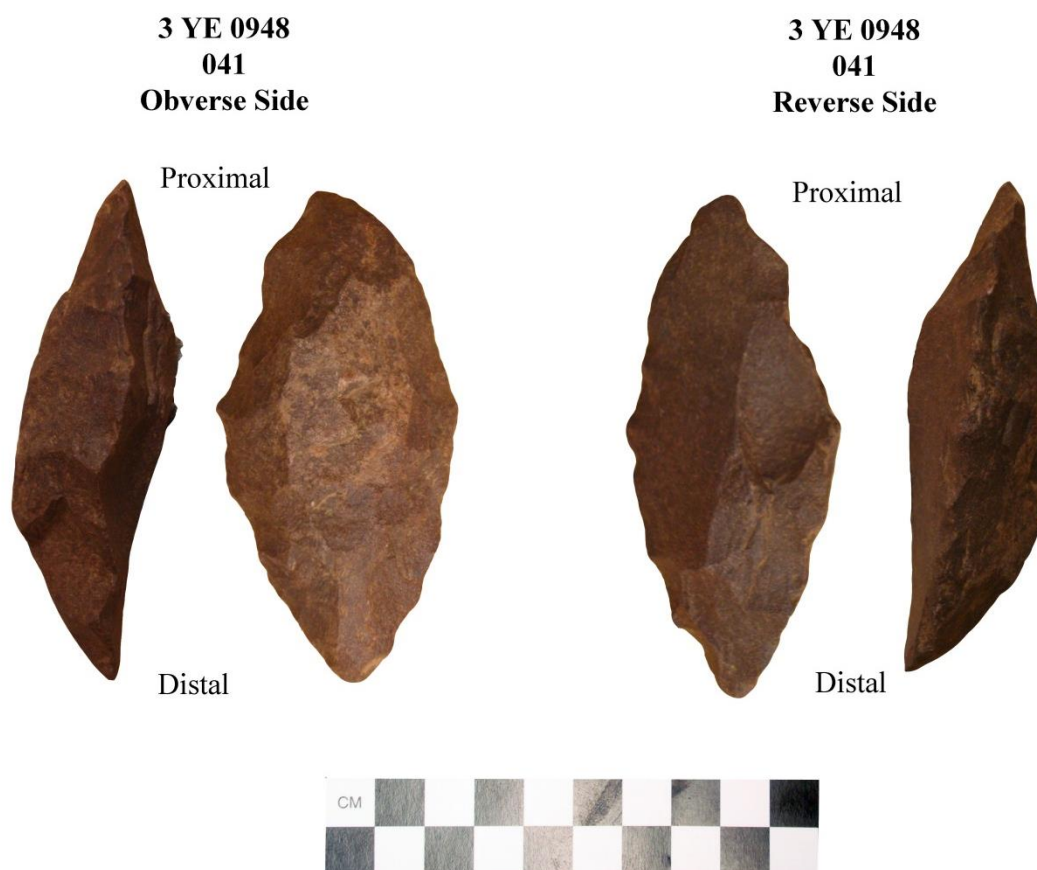


Figure 327. The obverse and reverse sides of Artifact 041.

3 YE 0948
041
Reverse Side

Proximal



Distal

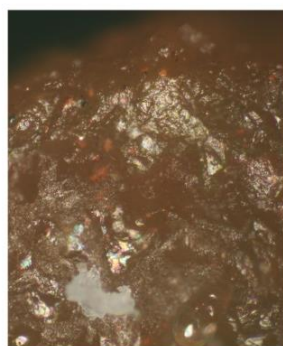
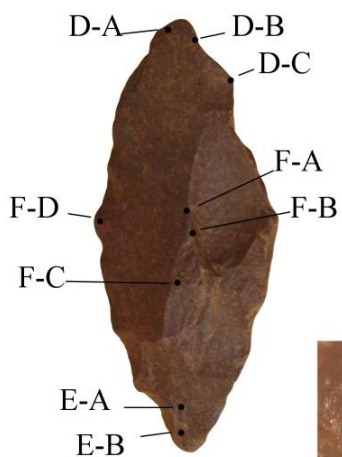


Figure 328. Casting location on the reverse side of Artifact 041.

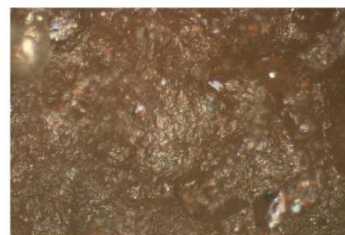
3 YE 0948

041

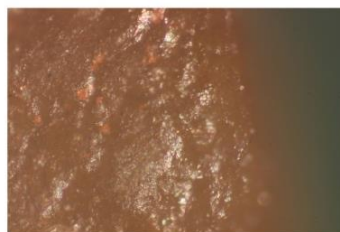
Reverse Side



.01 mm D-A 100x



.01 mm D-B 100x



.01 mm D-C 100x



Figure 329. Bit edge use-wear on the reverse side of Artifact 041, Locations D-A, D-B, and D-C, showing generalized abrasion and the beginnings of microplating.

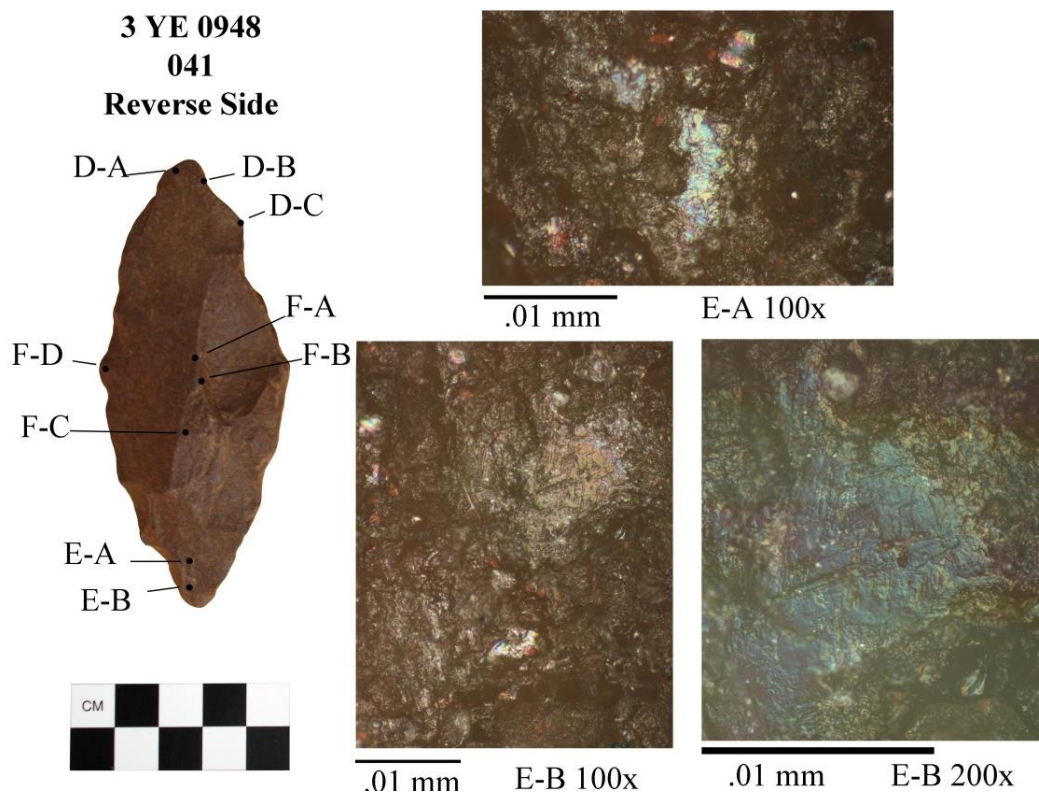


Figure 330. Bit edge wear on the reverse side of Artifact 041, Locations E-A and E-B, showing large portions of microplating and multi-directional striations.

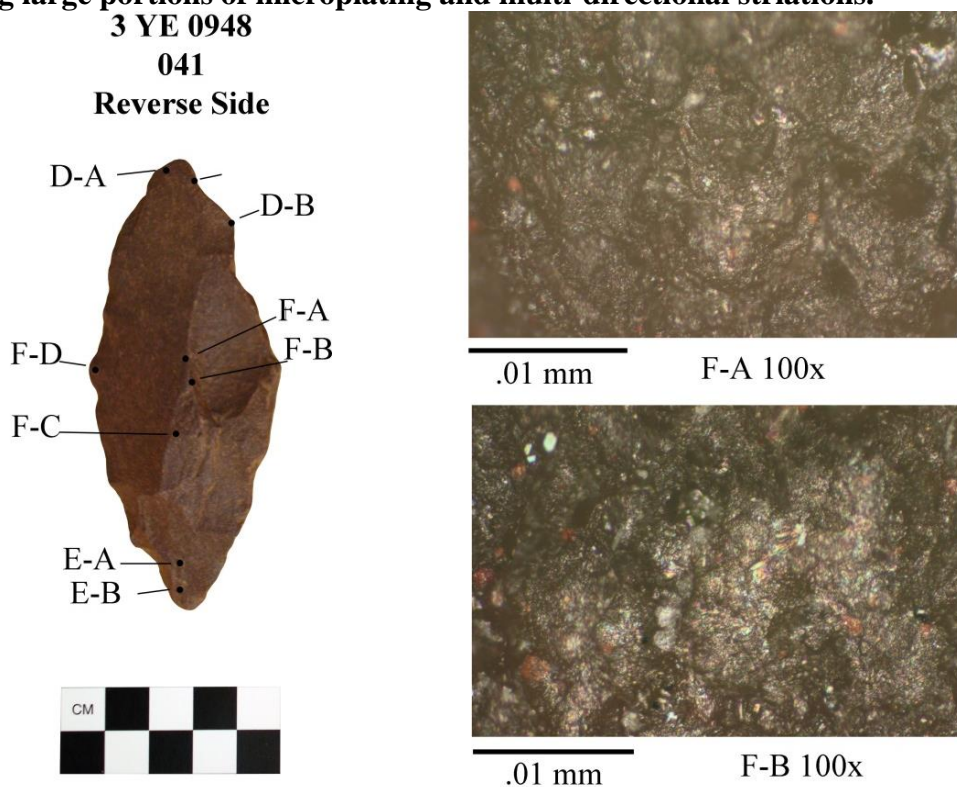


Figure 331. Hafting wear on the reverse side of Artifact 041, Locations F-A and F-B, showing generalized abrasion and light microplating.

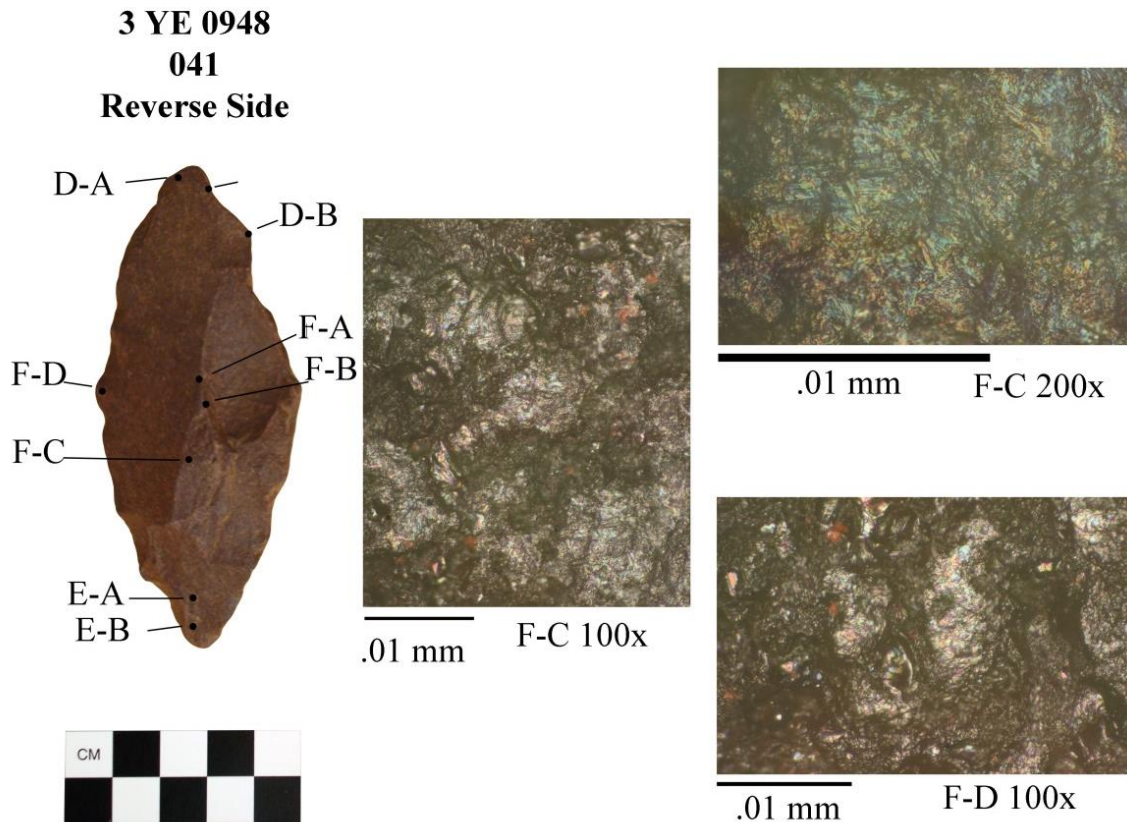


Figure 332. Hafting wear on the reverse side of Artifact 041, Locations F-C and F-D, showing heavy microplating and light multi-directional striation wear.

Artifact 042

Artifact 042 is a broken fragment of a tool made of silicified sandstone (Figure 333). This tool was placed in the single bitted category due to its distinctive shape. There is a dark inclusion on the obverse side of this tool. This area shows significant wear, as obvious polish and smoothing can be seen. Artifact 042 weights 52.7 grams with a length of 46.8 mm, maximum width of 49.6 mm and a thickness of 21.7 mm.

Casting

Only on cast was taken from Artifact 042, an obverse proximal (A) created from Batch 3. This is Cast #78 and measures 34.93 mm in length and 43.71 mm in width (Figure 334).

Use-wear

Bit edge wear consists of heavy abrasive damage, most likely substantial smoothing of previous microplating and numerous extensive locations of multi-directional striation wear (Figure 335-337).

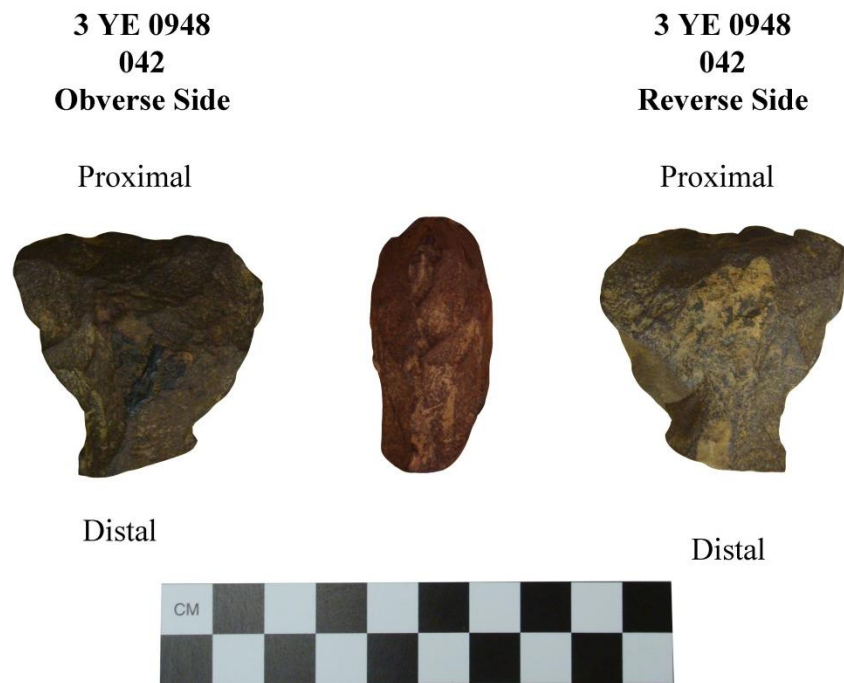


Figure 333. The obverse and reverse sides of Artifact 042.

3 YE 0948
042
Obverse Side

Proximal

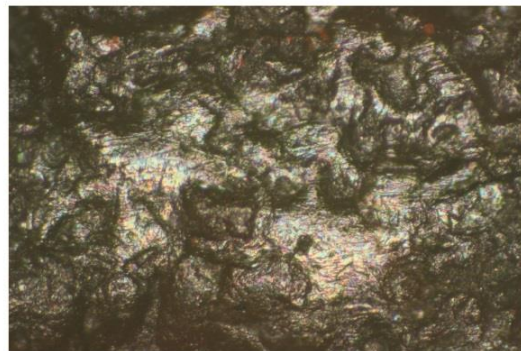
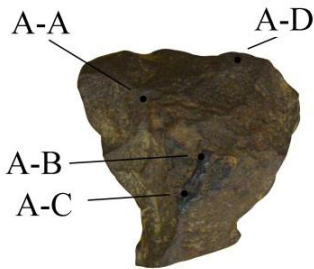


Distal



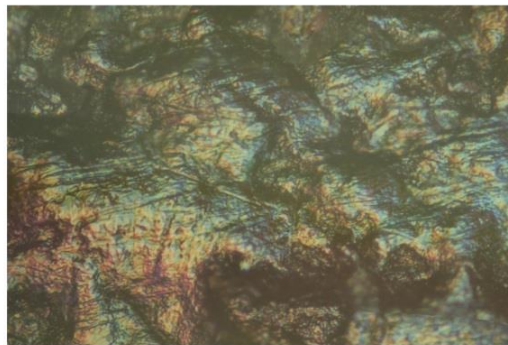
Figure 334. Casting location on Artifact 042.

3 YE 0948
042
Obverse Side



.01 mm

A-A 100x



.01 mm

A-A 200x

Figure 335. Bit edge wear on the obverse side of Artifact 042, Location A-A, showing additive wear which has been scraped down in a cleaning motion with multi-directional striations.

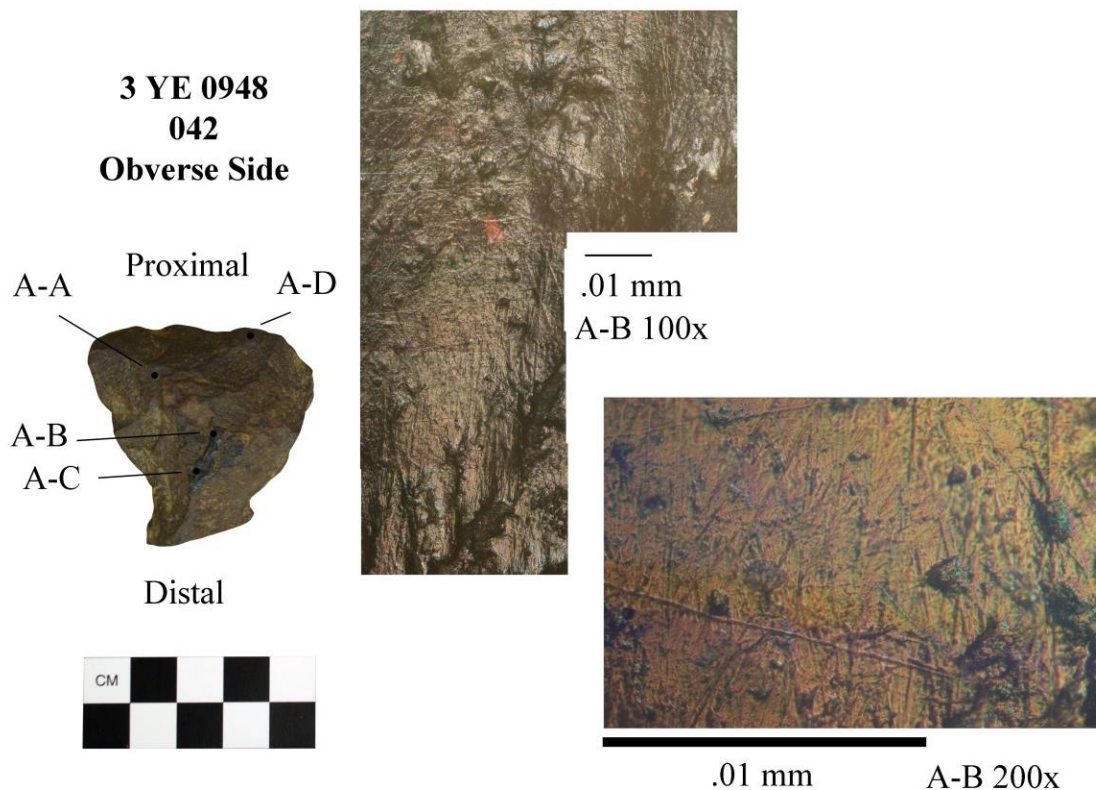


Figure 336. Bit edge wear on the obverse side of Artifact 042, Location A-B, showing large additive wear with heavy abrasive wear on top in the form of multi-directional striations.

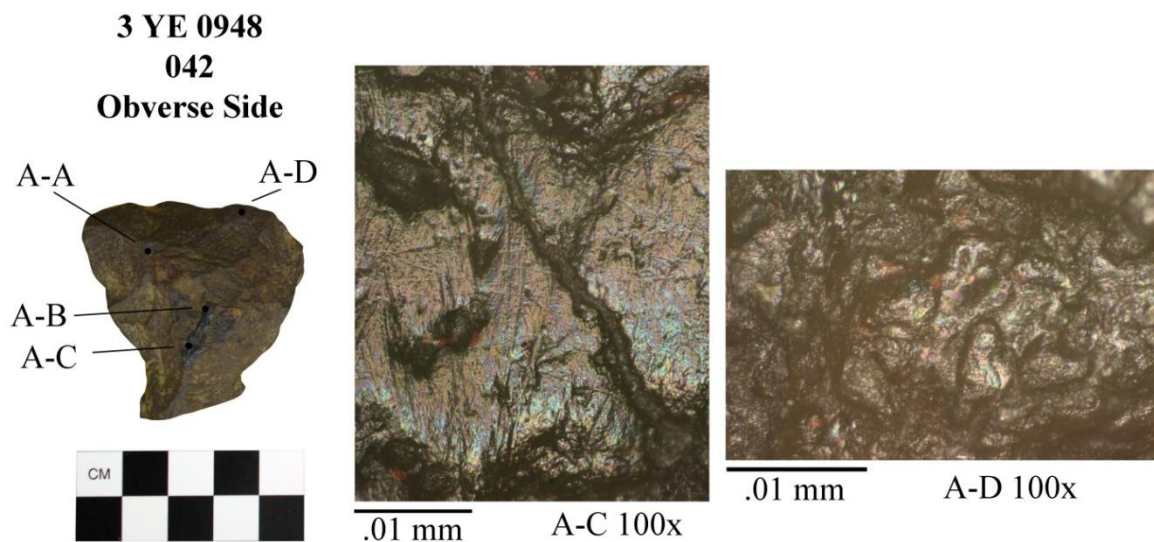


Figure 337. Bit wear on the obverse side of Artifact 042, Locations A-C and A-D, showing heavy additive wear, followed by abrasive wear in the form of multi-directional striations.

Artifact 043

Artifact 043 is a fragmented portion of a tool made of silicified sandstone (Figure 338). Only a small portion of worked edge is present. Tool was likely damaged due to heat exposure. The tool was most likely a portion of a double bitted tool, as there appears to be a small portion of hafting. There is evidence of wear polish on both sides of the tool. Artifact 043 weighs 86.6 grams, with a length of 62.0 mm, a width of 46.5 mm and a thickness of 20.3 mm.

Casting

Artifact 043 had only one cast produced, an obverse proximal (A), created in Batch11. This is Cast #79 and it measures in at 31.89 mm in length and 43.9 mm in width (Figure 339).

Use-wear

Bit edge wear consist of microplating wear with striations running in multiple directions. Some of the microplating is directional and there is some light generalized abrasion present (Figures 340-342).



Figure 338. The obverse and reverse sides of Artifact 043.

3 YE 0948
043
Obverse Side

Proximal

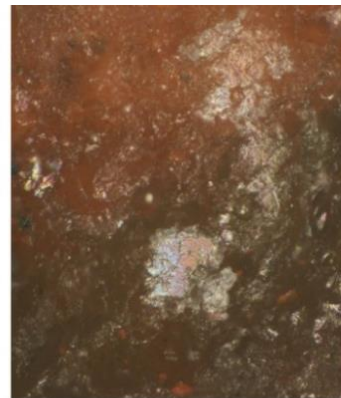
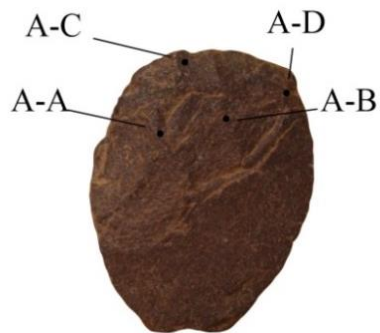


Distal

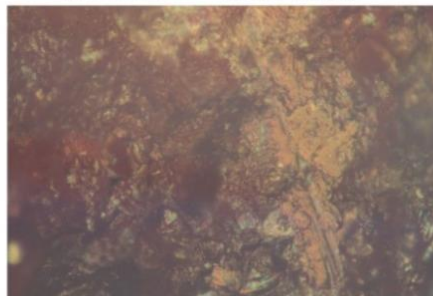


Figure 339. Casting location on the obverse side of Artifact 043.

3 YE 0948
043
Obverse Side



.01 mm A-A 100x



.01 mm A-A 200x

Figure 340. Bit wear on the obverse side of Artifact 043, Location A-A, showing microplating additive wear and light strational wear running obliquely perpendicular to the bit edge.

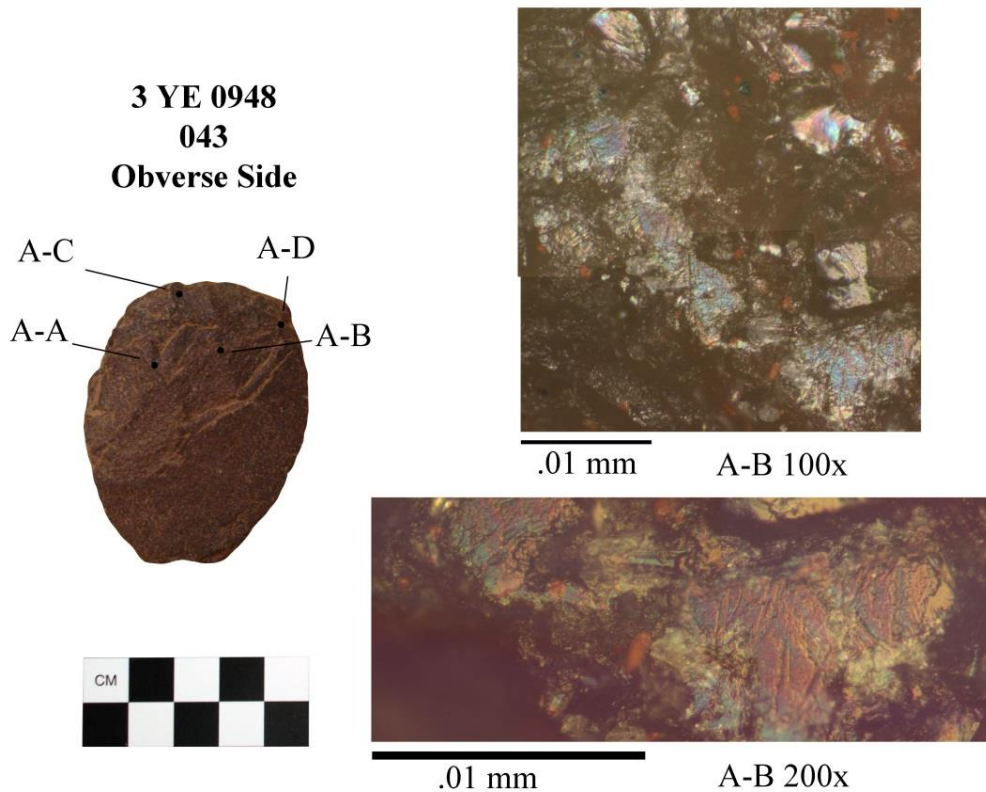


Figure 341. Bit edge wear on the obverse side of Artifact 043, Location A-B, showing microplating additive wear and light strational wear running mostly perpendicular to the bit edge.

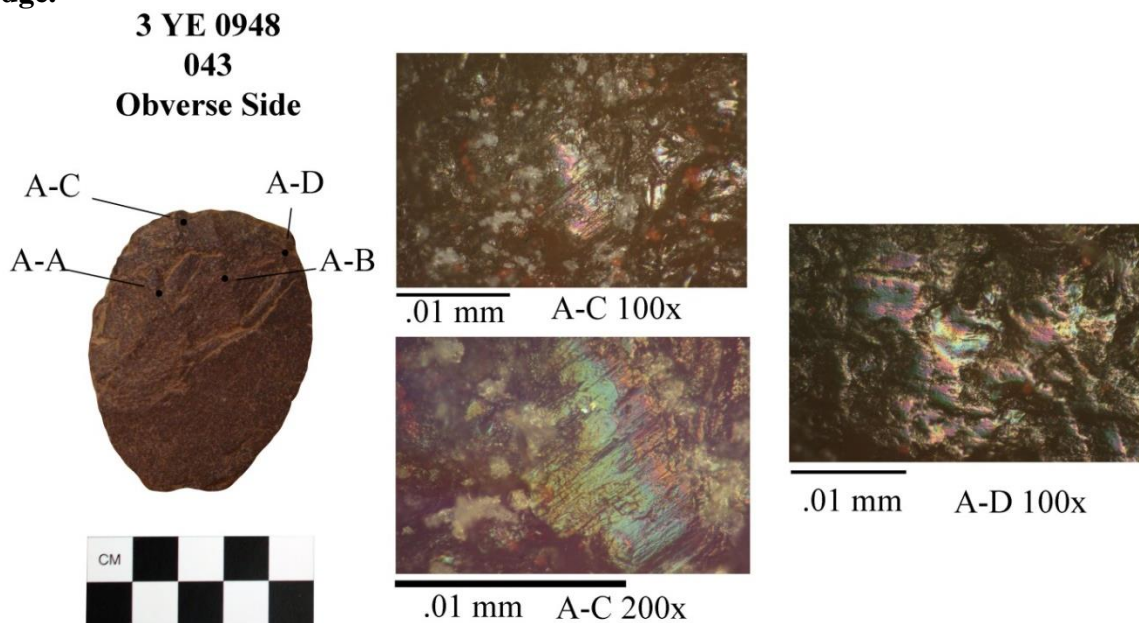


Figure 342. Directional bit edge wear on the obverse side of Artifact 043, Locations A-C and A-D, showing microplating additive wear and abrasive wear in the form of obliquely angled striations.

Artifact 044

Artifact 044 is a broken portion of a tool edge (Figure 343). Polish can be seen on the obverse side and edges are slightly grounded. Bending fracture at the point of damage, suggest the tool failed during use. Artifact 044 weights 47.1 grams with a length of 35.6 mm, a maximum width of 67.9 mm and a thickness of 16.7mm.

Casting

Only one cast was taken from Artifact 044, a reverse proximal (D). Created out of Batch 5, this is Cast #80, which measures 29.29 mm in length and 46.58 mm in width (Figure 344).

Use-wear

Bit wear consist of large sections of microplating wear with light generalized abrasion (Figure 345).



Figure 343. The obverse and reverse sides of Artifact 044.

3 YE 0948
044
Reverse Side

Proximal

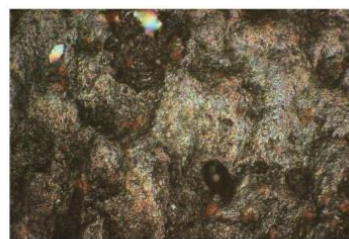
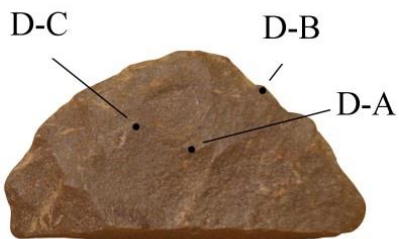


Distal

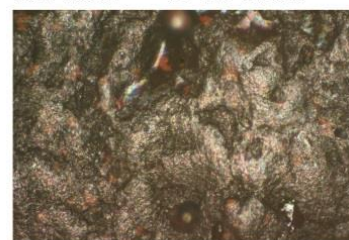


Figure 344. Casting location on the reverse side of Artifact 044.

3 YE 0948
044
Reverse Side



.01 mm D-A 100x



.01 mm D-B 100x



.01 mm D-C 100x

Figure 345. Bit edge wear on the reverse side of Artifact 044, Locations D-A, D-B and D-C, showing extensive additive wear with light abrasion.

Artifact 045

Artifact 045 is a small fragment of a damaged double bitted tool (Figure 346). Part of the proximal edge and a small portion of the hafting area are intact. Composed of silicified sandstone, the edges are sharp with little grinding and some hafting polish can be seen. The tool was most likely damaged during use, due to the bending fracture at the damaged portion. Artifact 045 weighs 49.9 grams, with a length of 40.4 mm, a width of 58.5 mm and a thickness of 21.0 mm.

Casting

Two casts were generated from Artifact 045, a proximal (A) and a haft (C), both from the obverse side. Cast # 81, the obverse proximal was produced from Batch 4 and measured 14.68 mm in length by 42.32 mm in width. Cast #82, the obverse haft, was created from Batch 9 and measures in at 45.85mm in length and 16.06 mm in width (Figure 347).

Use-wear

Bit edge wear consist of generalized abrasion with some microplating and directional scraping striations. Hafting wear shows microplating with striations running perpendicular to the longitudinal axis of the tool with some generalized light abrasion (Figures 348 -353).



Figure 346. The obverse and reverse sides of Artifact 045.

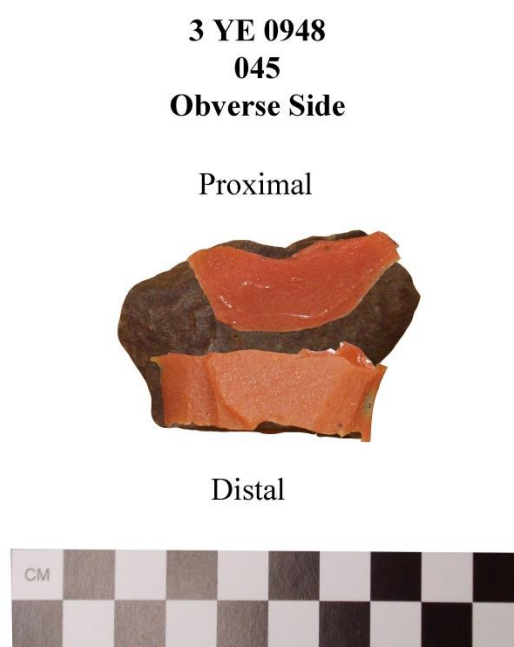
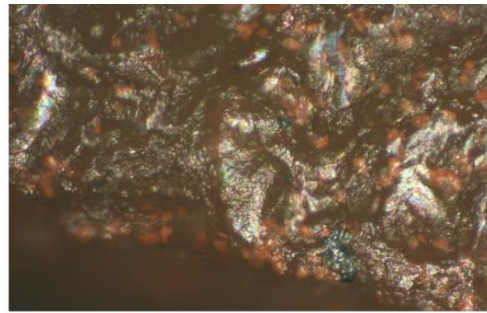
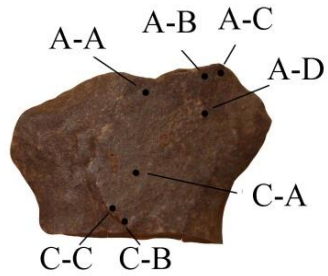


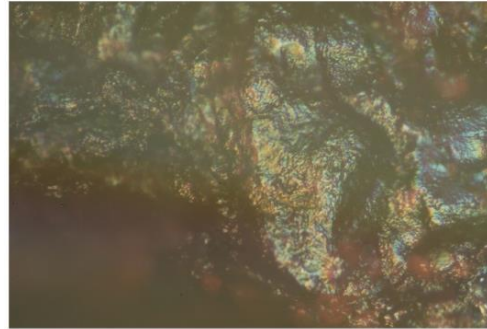
Figure 347. Casting locations on the obverse side of Artifact 045.

3 YE 0948
045
Obverse Side



.01 mm

A-A 100x

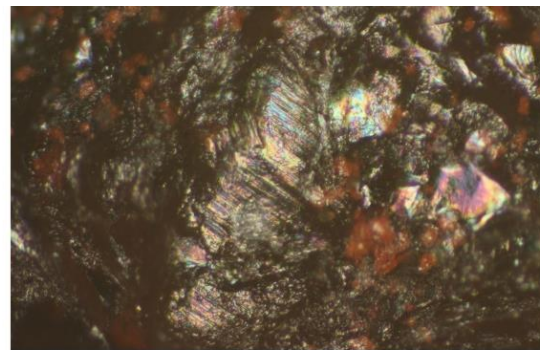
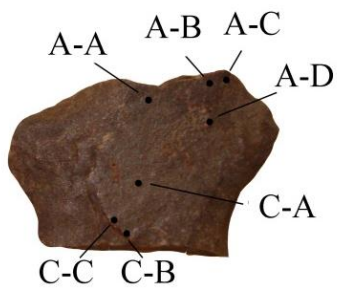


.01 mm

A-A 200x

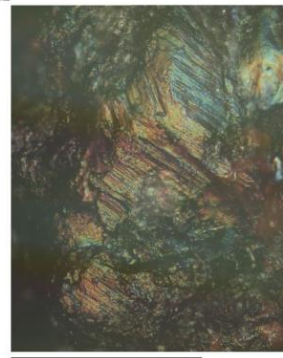
Figure 348. Bit edge wear on the obverse side of Artifact 045, Location A-A, showing additive and abrasive wear.

3 YE 0948
045
Obverse Side



.01 mm

A-B 100x



.01 mm A-B 200x

Figure 349. Bit edge wear on the obverse side of Artifact 045, Location A-B, showing additive and abrasive wear.

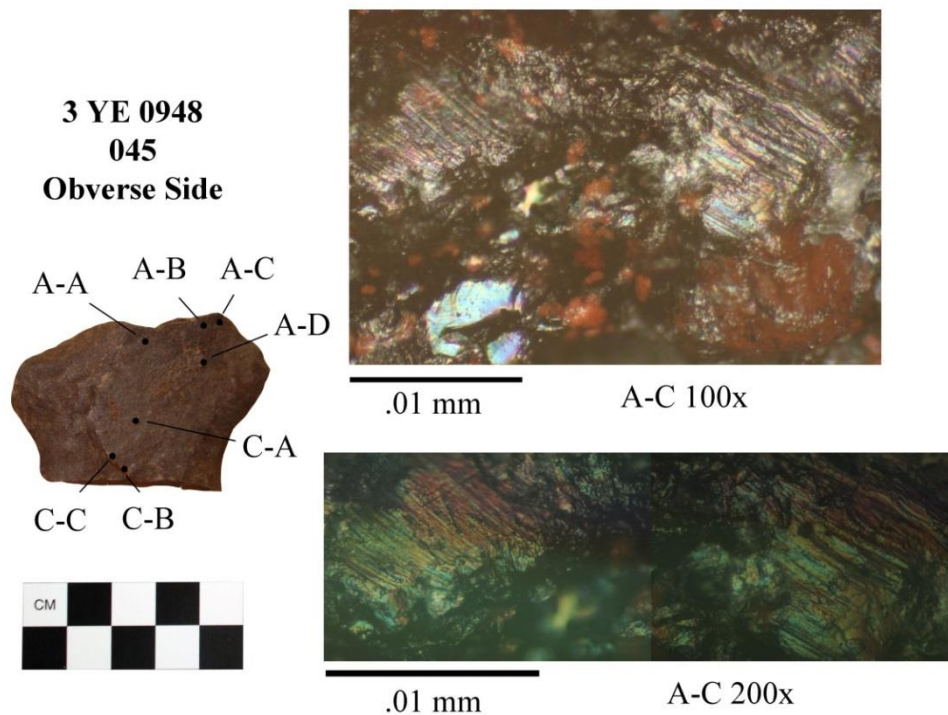


Figure 350. Bit edge wear on the obverse side of Artifact 045, Location A-C, showing large additive wear and obliquely angled striation wear.

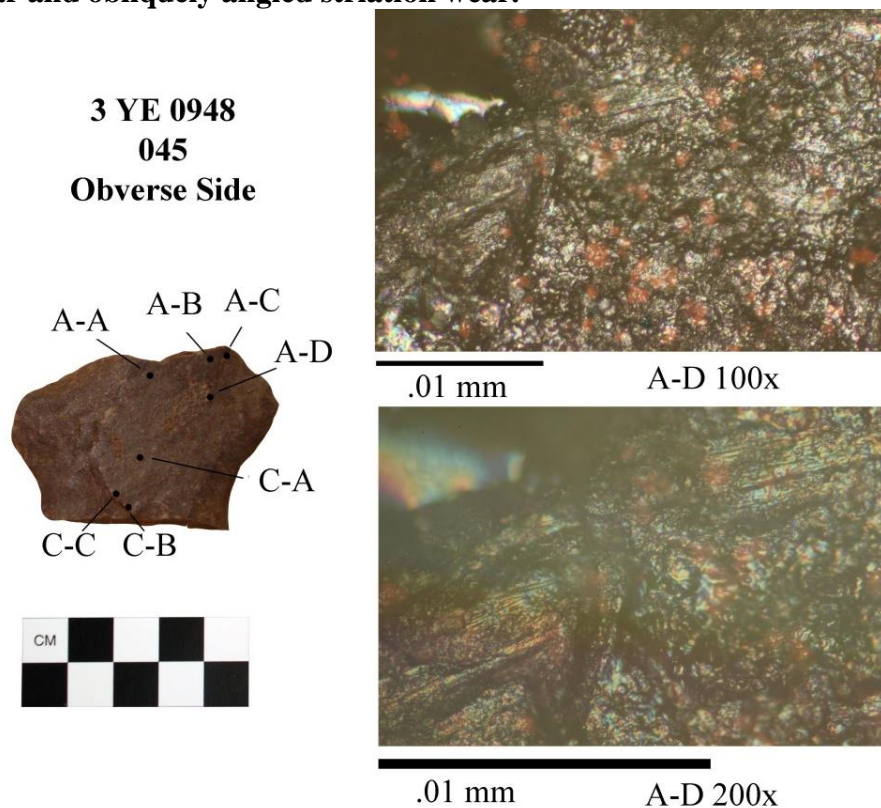


Figure 351. Bit edge wear on the obverse side of Artifact 045, Location A-D, showing heavy additive and abrasive wear in the form of microplating, and striations.

3 YE 0948
045
Obverse Side

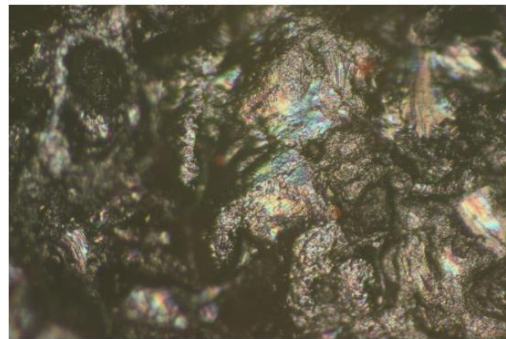
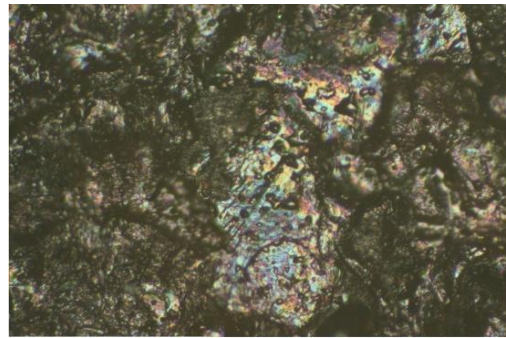
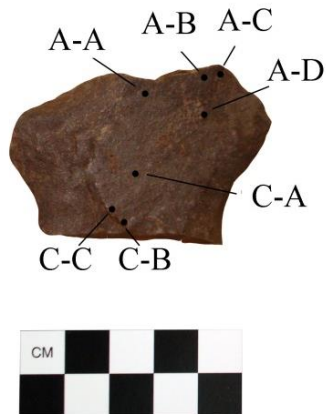


Figure 352. Hafting wear on the obverse side of Artifact 045, Location C-A and C-B, showing casting error (C-A) in the form of oil build up and light abrasion and microplating (C-B).

3 YE 0948
045
Obverse Side

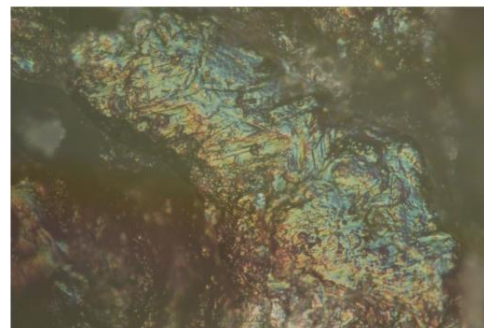
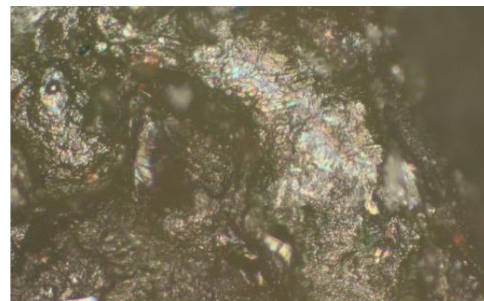
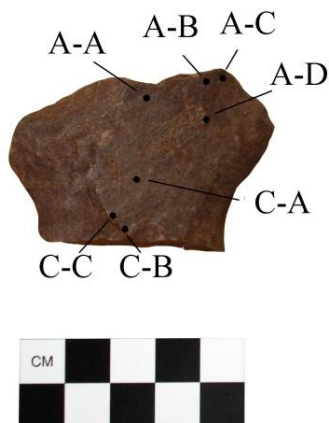


Figure 353. Hafting wear on the obverse side of Artifact 045, Location C-C, showing large additive wear with multi-directional striations.

Artifact 046

Artifact 046 is a small broken portion of a tool made of silicified sandstone and was placed in the single bitted tool category (Figure 354). There are portions of polish visible and tool edges are quite sharp with little smoothing or grinding. Tool does not appear to have been modified or recycled as the broken edge shows no evidence of impact or grinding from use as a wedge or hammerstone. Artifact 046 weighs 37.3 grams with a length of 50.8 mm, a maximum width of 38.0 mm and a thickness of 20.3 mm.

Casting

Only one cast was taken of Artifact 046, a reverse proximal (D) created from Batch 5. This is Cast #83 and its dimensions are 30.25 mm in length and 37.59 mm in width (Figure 355)

Use-wear

Bit edge wear consists of heavy microplating in large plane-like portions on the tool. Numerous multi-directional striations can be seen, some of which are partially filled in (Figures 356- 358).

**3 YE 0948
046
Obverse Side**

Proximal



Distal

**3 YE 0948
046
Reverse Side**

Proximal



Distal



Figure 354. The obverse and reverse side of Artifact 046.

**3 YE 0948
046
Reverse Side**

Proximal



Distal



Figure 355. Casting location on Artifact 046.

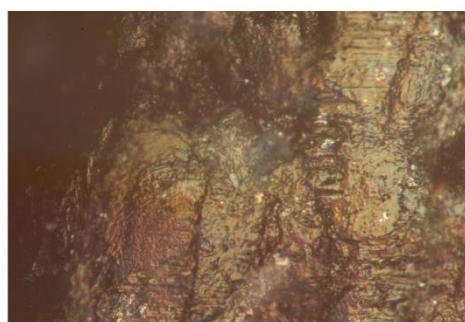
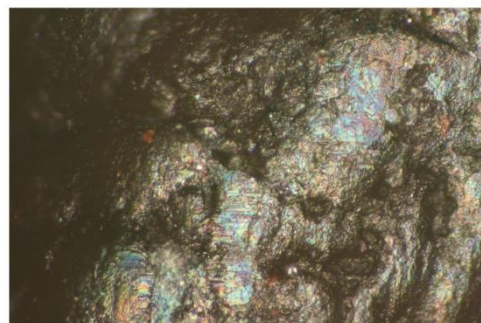
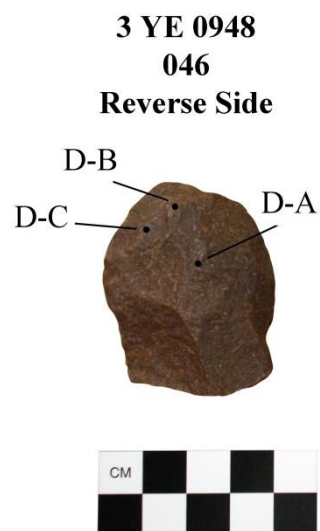


Figure 356. Bit edge wear on the reverse side of Artifact 046, Location D-A, showing heavy microplating with light striation wear.

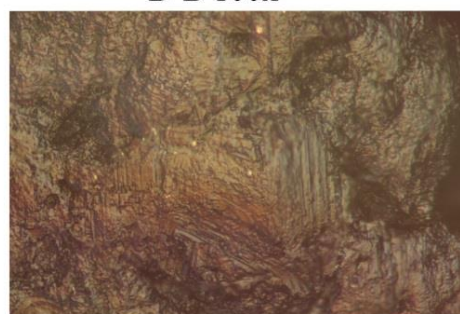
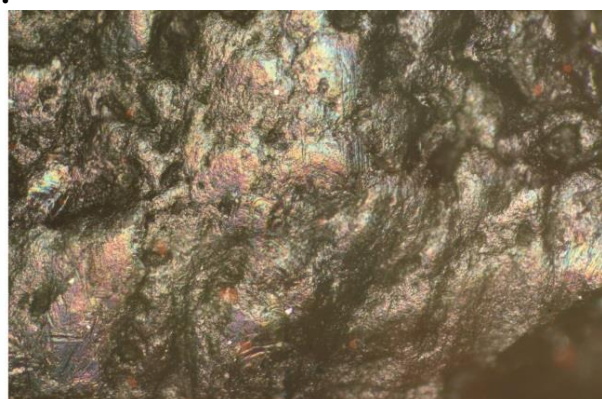
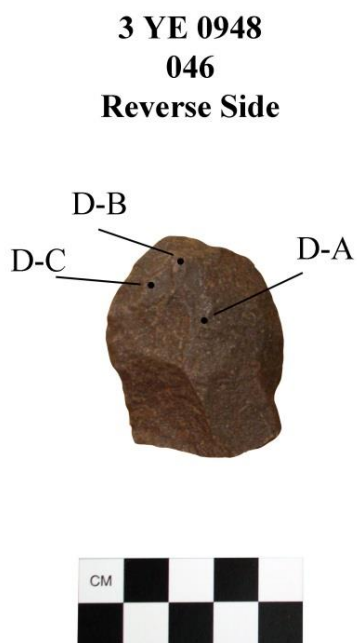


Figure 357. Bit edge wear on the reverse side of Artifact 046, Location D-B, showing heavy additive wear with numerous multi-directional striations.

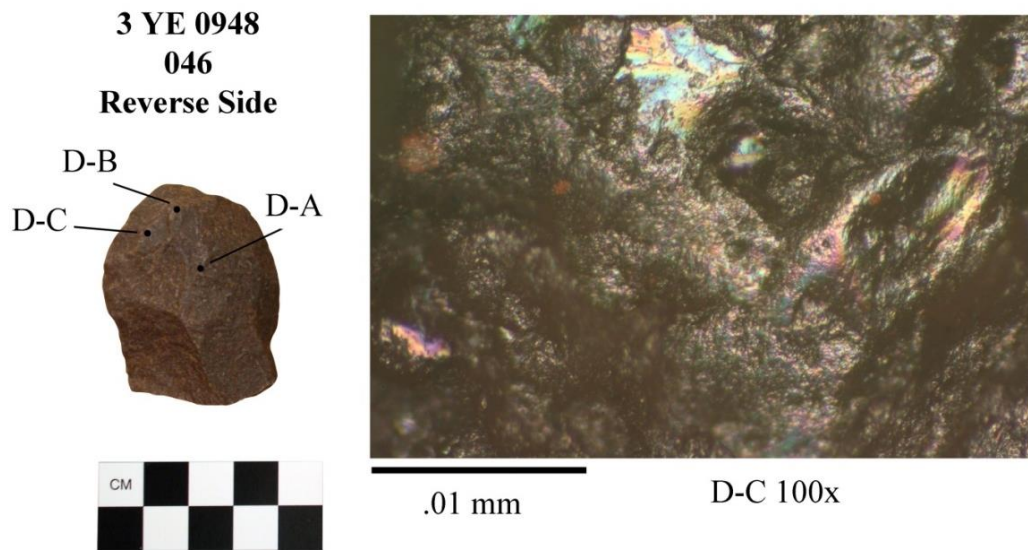


Figure 358. Bit edge wear on the reverse side of Artifact 046, Location D-C, showing light abrasive wear.

Artifact 047

Artifact 047 is a fragmented piece of a tool made of silicified sandstone (Figure 359). This is a portion of a double bitted tool that has been so fragment that only a portion blade and hafting area are intact. The damage to the artifact is most likely due to heat. The tool edge that remains intact is smoothed significantly. There is also a step fracture which can be seen near the edge of the tool. Artifact 047 weighs 23.6 grams, with a length of 45.1mm, a width of 29.5 mm and a thickness of 14.7 mm.

Casting

Artifact 047 produced only once cast, Cast #84. This cast represents the obverse proximal portion of the tool. Due the fragmented nature of this tool, only a portion of this edge area was captured, and measures 17.37 mm in length and 21.62 mm in width (Figure 360).

Use-wear

Wear on this tool consists of light microflaking with generalized abrasive wear (Figure 361).



Figure 359. The obverse and reverse sides of Artifact 047.



Figure 360. Casting location on the obverse side of Artifact 047.

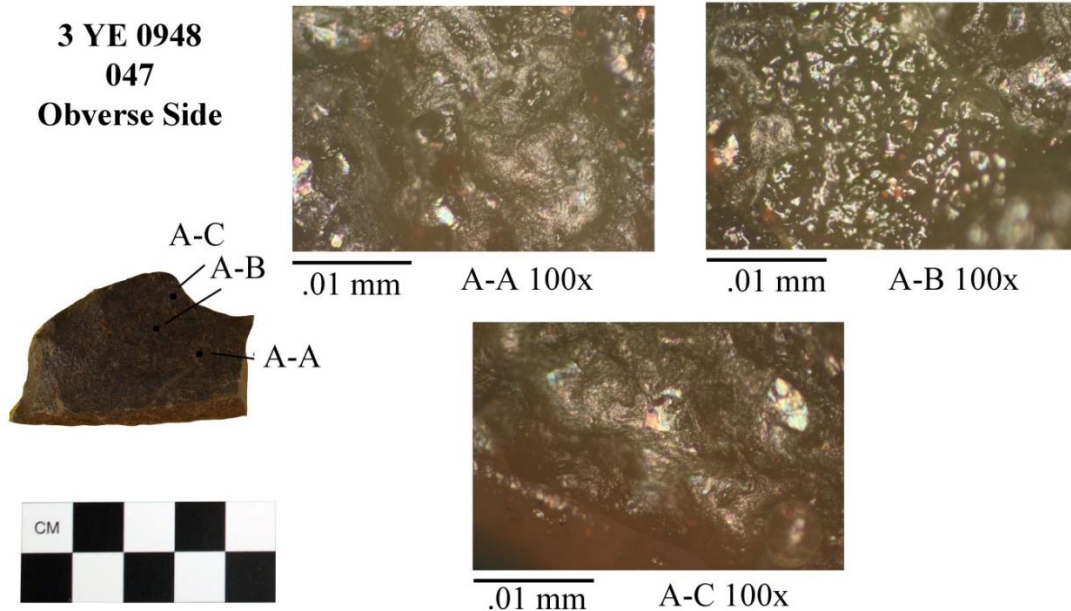


Figure 361. Hafting wear on the obverse side of Artifact 047, Locations A-A, A-B and A-C, showing light abrasive wear with the beginnings of additive wear (A-A and A-C) and casting error in the form of oil or grease on the cast.

Artifact 048

Artifact 048 is a fragmented piece of a double bitted tool with only the hafting portion intact (Figure 362). This tool portion is made of silicified sandstone and hafting polish is present on both sides of the tool. Tool was most likely damaged due to heat exposure. Artifact 048 weighs 44.3 grams with a length of 61.0 mm, maximum width of 39.0 mm and a thickness of 17.2 mm.

Casting

Only one cast was taken from Artifact 048, an obverse haft (C) produced from Batch 4. This is Cast #85 and it measures in at 18.4 mm in length by 32.12 mm in width (Figure 363).

Use-wear

Hafting wear consists of generalized abrasion with the beginnings of microplating present (Figure 364).



Figure 362. The obverse and reverse sides of Artifact 048.

3 YE 0948
048
Obverse Side

Proximal

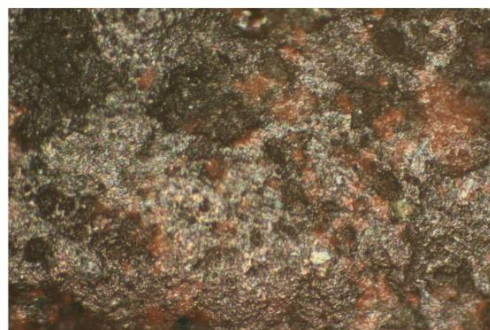
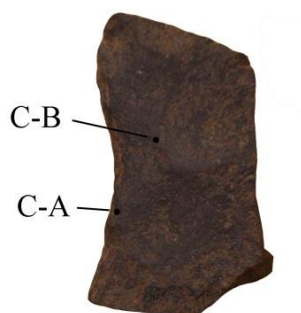


Distal



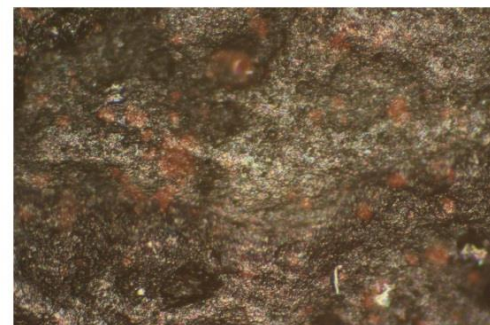
Figure 363. Casting location on the obverse side of Artifact 048.

3 YE 0948
048
Obverse Side



.01 mm

C-A 100x



.01 mm

C-B 100x

Figure 364. Hafting wear on the obverse side of Artifact 048, Locations C-A and C-B, showing directional abrasive wear.

Artifact 049

Artifact 049 is the broken edge of a tool made of silicified sandstone (Figure 365). The reverse side of the tool has numerous step fractures near the bit edge. The edges have some grinding, but are roughly knapped. Artifact 049 weighs 72.4 grams, with a length of 35.7 mm, a width of 68.0 mm and a thickness of 28.0 mm.

Casting

Artifact 049 produced only one cast, an obverse proximal (A) taken from Batch 10. This is Cast #86 and its dimensions are 23.82 mm in length and 49.37 mm in width (Figure 366).

Use-wear

Bit edge wear consists of light microplating and generalized abrasion (Figure 367).

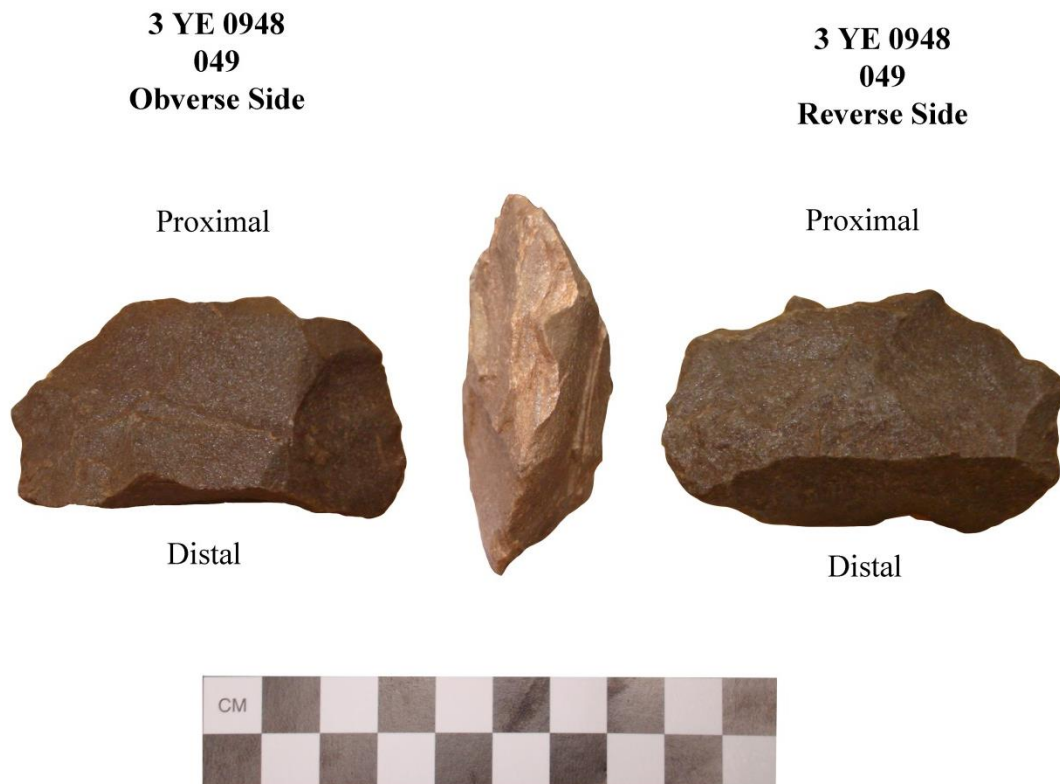


Figure 365. The obverse and reverse sides of Artifact 049.

**3 YE 0948
049
Obverse Side**

Proximal



Distal

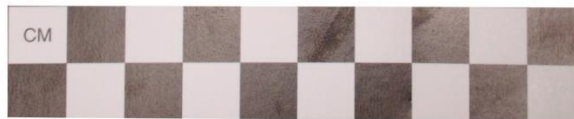
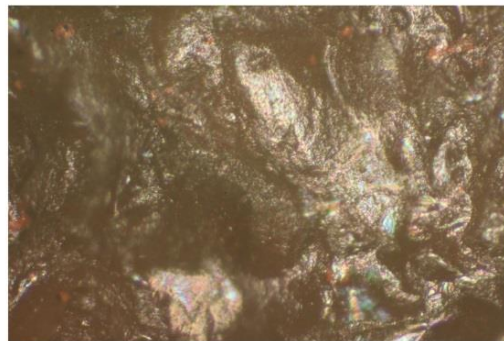
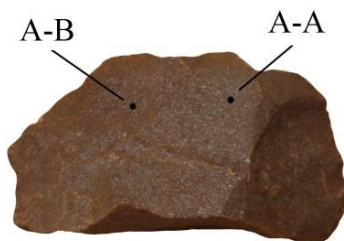
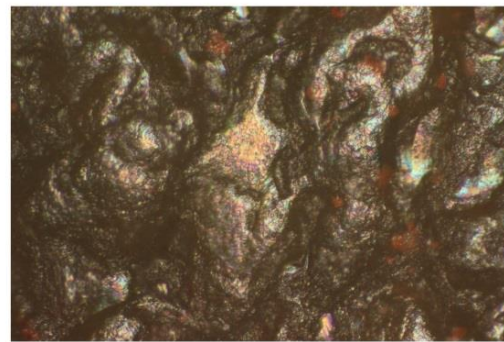


Figure 366. Casting location on the obverse side of Artifact 049.

**3 YE 0948
049
Obverse Side**



A-A 100x



A-B 100x

Figure 367. Bit edge wear on the obverse side of Artifact 049, Locations A-A and A-B, showing abrasive wear and the beginnings of additive wear.

Artifact 050

Artifact 050 is the small fractured edge of a tool made of silicified sandstone (Figure 368). The tool does not appear to have been modified or recycled as there is no evidence of impact or grinding on the broken end of the tool. Artifact 050 weighs 28.2 grams with a length of 29.6 mm, a maximum width of 54.4 mm and a thickness of 16.7 mm.

Casting

Only one cast was taken from Artifact 050, an obverse proximal (A) created out of Batch 5. This is Cast # 87 and its measurements are 28.64 mm in length by 39.65 mm in width (Figure 369).

Use-wear

Bit edge wear consists of generalized abrasion with the beginnings of microplating (Figure 370).



Figure 368. The obverse and reverse sides of Artifact 050.

3 YE 0948
050
Obverse Side

Proximal

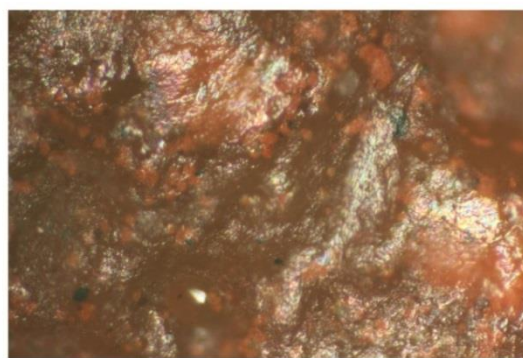
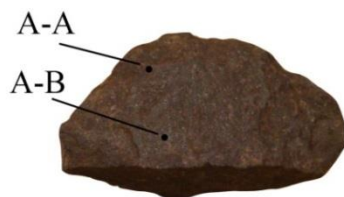


Distal



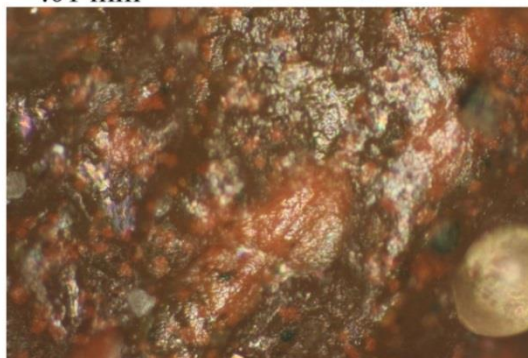
Figure 369. Casting location on Artifact 050.

3 YE 0948
050
Obverse Side



.01 mm

A-A 100x



.01 mm

A-B 100x

Figure 370. Bit edge wear on the obverse side of Artifact 050, Locations A-A and A-B, showing abrasive wear and the beginnings of additive wear.

Artifact 051

Artifact 051 is a broken edge of tool made of silicified sandstone (Figure 371). The edges of the tool are sharp with little grinding or smoothing visible. Tool was most likely damaged during use, due to the bending fracture present at the damaged end. There is no evidence that the tool was recycled for use as a hammerstone or wedge and there is no visible evidence of impact or grinding on the broken edge. Artifact 051 weighs 49.6 grams, with a length of 42.8mm, a width of 47.0 mm and a thickness of 24.9 mm.

Casting

Artifact 051 had only one cast taken, a reverse proximal (D) created from Batch 3. This is Cast #88 and its dimensions are 23.47 mm in length and 36.2 mm in width (Figure 372).

Use-wear

Bit edge wear has light microplating with few striations running perpendicular to the bit edge and a little generalized abrasion (Figure 373).

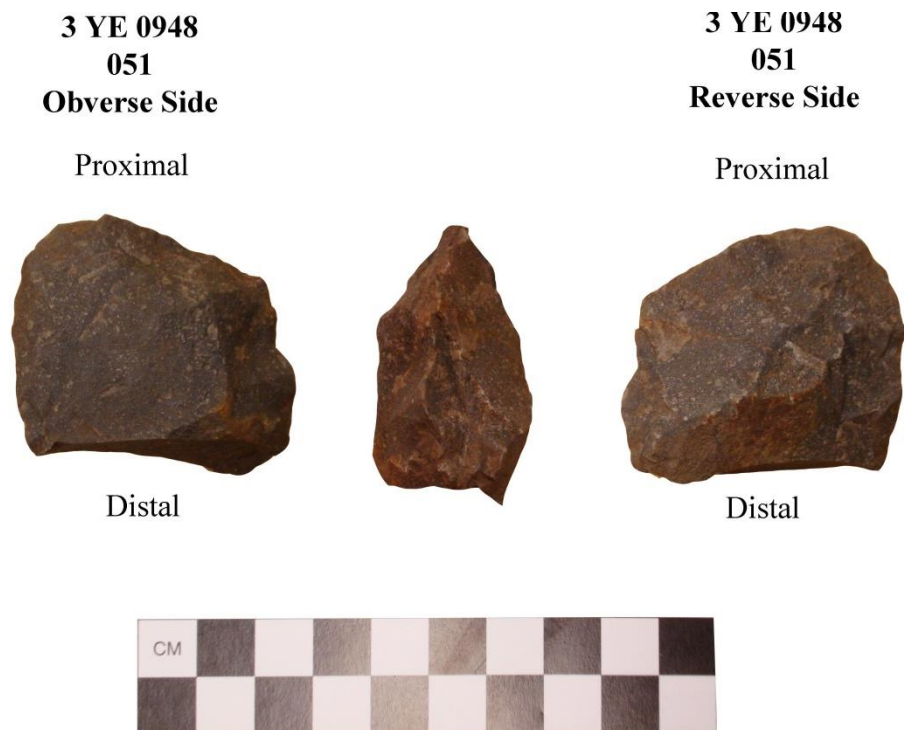


Figure 371. The obverse and reverse sides of Artifact 051.

3 YE 0948
051
Reverse Side

Proximal

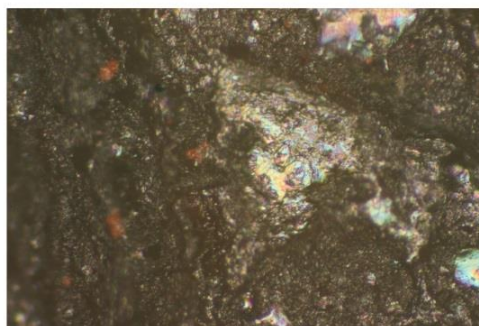
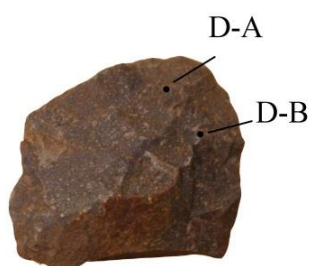


Distal



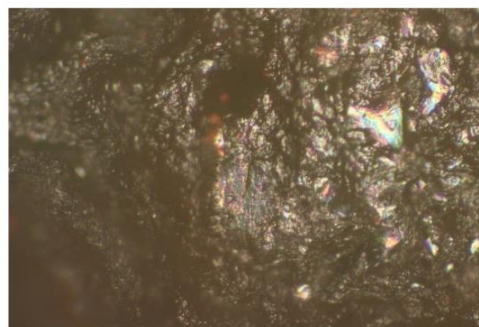
Figure 372. Casting location on the reverse side of Artifact 051.

3YE 0948
051
Reverse Side



.01 mm

D-A 100x



.01 mm

D-B 100x

Figure 373. Bit edge wear on the reverse side of Artifact 051, Location D-A and D-B, showing light additive and abrasive wear with slight microplating and striation wear running perpendicular to bit edge.

Artifact 052

Artifact 052 is a small elongated tool made of silicified sandstone (Figure 374). There is no obvious hafting or use wear. There is no evidence of grinding on any of the edges of the tool. Artifact 052 weighs 29.4 grams with a length of 58.0 mm, a maximum width of 31.0 and thickness of 15.3 mm.

Casting

Only one cast was taken from Artifact 052, an obverse proximal created from Batch 2. This is Cast #89 and it measures in at 19.29 mm in length by 52.97 mm in width (Figure 375).

Use-wear

While a small tool, Artifact 052 has substantial use-wear present. Bit wear consists of heavy microplating wear with numerous multi-directional striations. The hafting wear shows microplating and some light generalized abrasion (Figures 376-379).

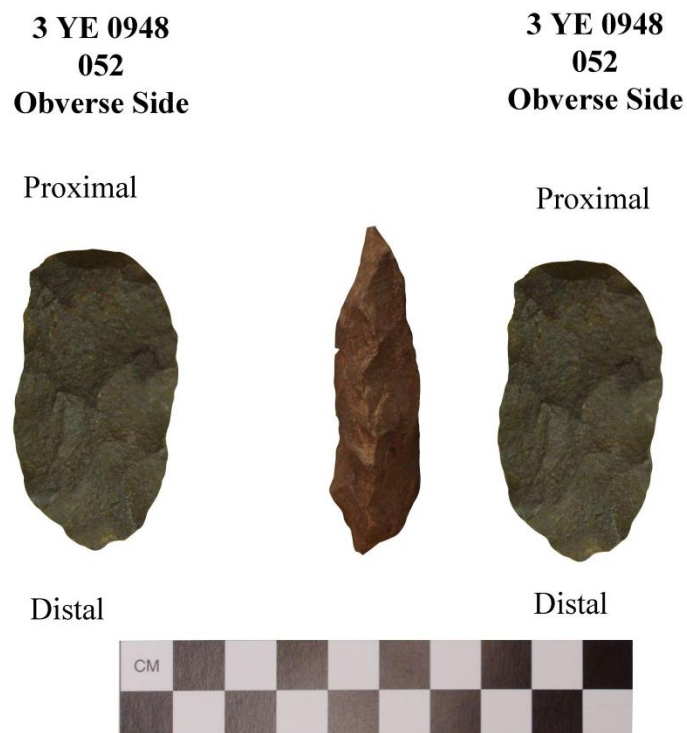


Figure 374. The obverse and reverse side of Artifact 052.

3 YE 0948
052
Obverse Side

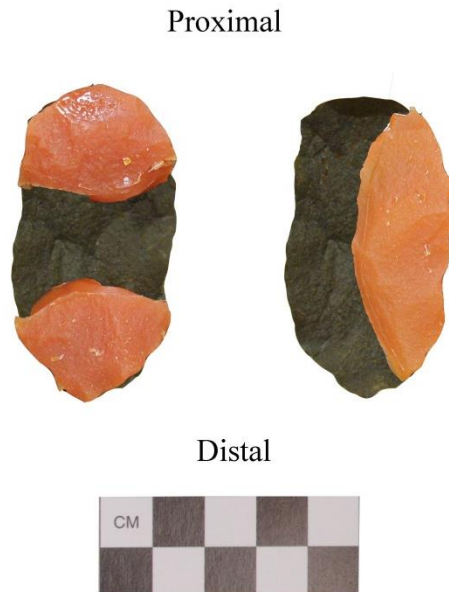
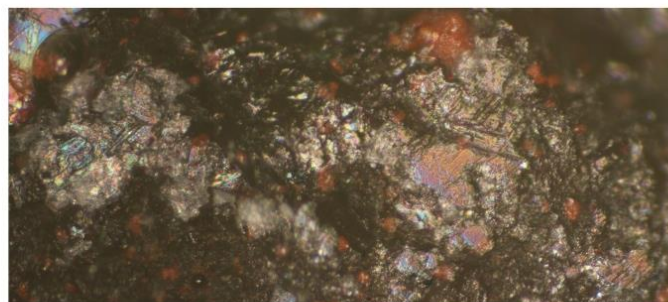
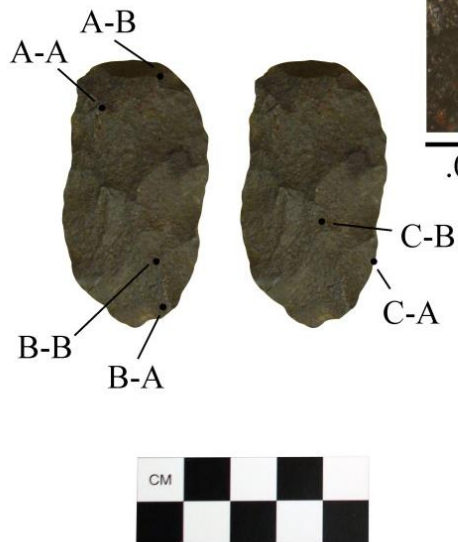
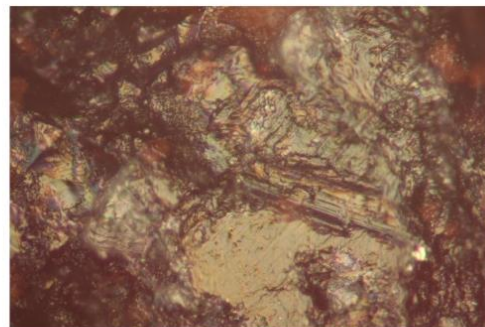


Figure 375. Casting locations on the obverse side of Artifact 052.

3 YE 0948
052
Obverse Side



.01 mm A-A 100x



.01 mm A-A 200x

Figure 376. Bit edge wear on the obverse side of Artifact 052, Location A-A, showing large microplating additive wear with multi-directional striation wear.

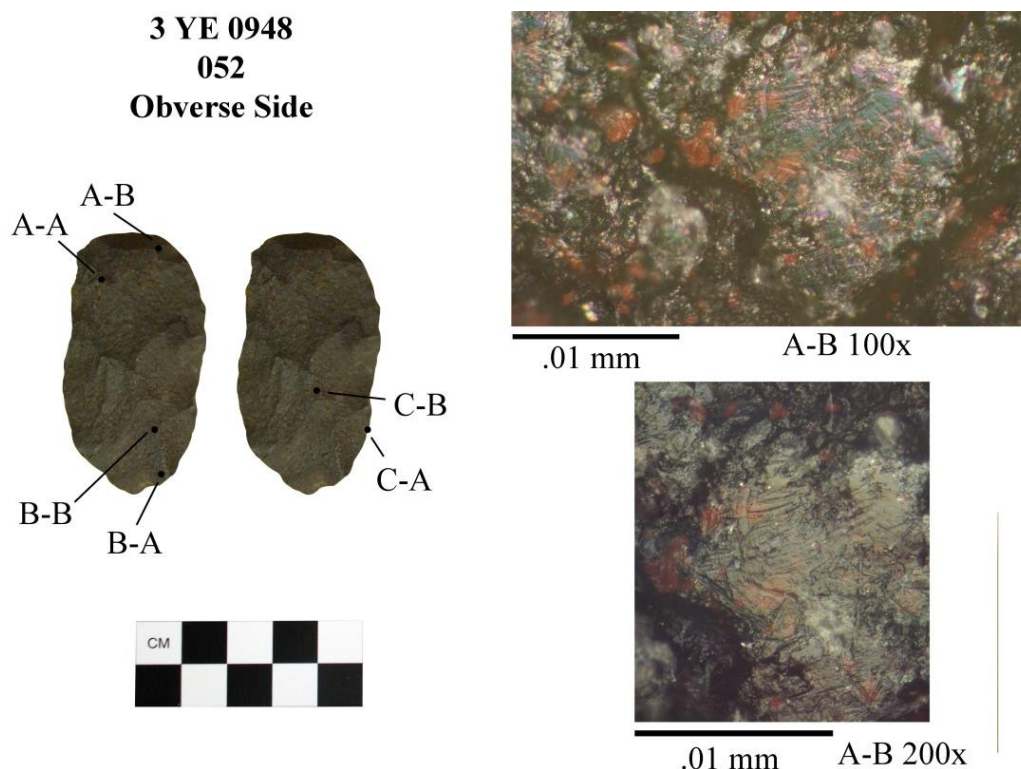


Figure 377. Bit edge wear on the obverse side of Artifact 052, Location A-B, showing heavy microplating wear with multi-directional striation wear.

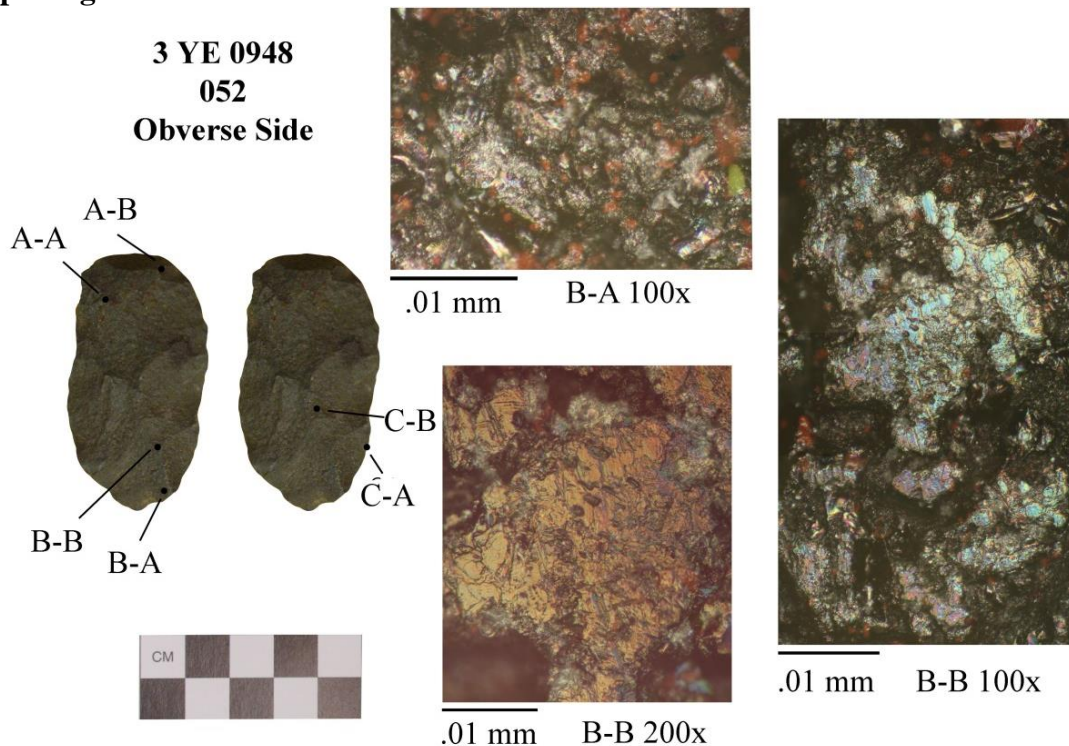


Figure 378. Bit edge wear on the obverse side of Artifact 052, Locations B-A and B-B, showing light abrasive wear, heavy microplating and multi-directional striations.

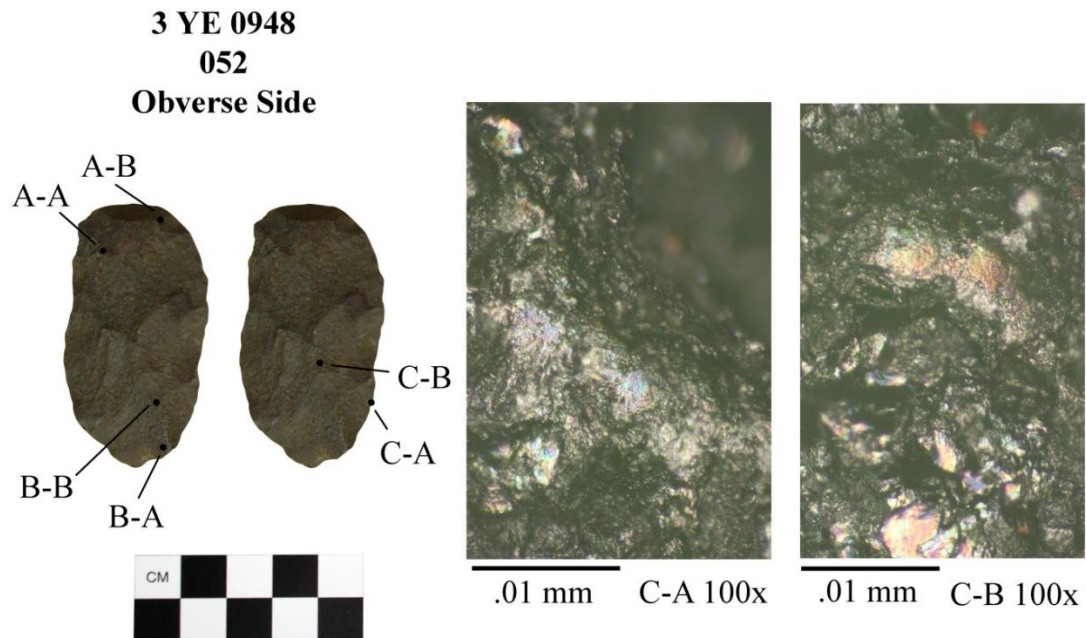


Figure 379. Hafting wear on the obverse side of Artifact 052, Locations C-A and C-B, showing light abrasive wear with the beginnings of additive wear.

Artifact 053

Artifact 053 is an elongated tool form made of silicified sandstone (Figure 380). There is no evidence of smoothing on any of the edges on the tool. Artifact 053 weighs 41.7 grams, with a length of 50.4 mm, a width of 34.4 mm and a thickness of 26.4 mm.

Casting

Only one cast was taken from Artifact 053, an obverse proximal produced from Batch 2. This is Cast #90 and measures in a 15.32 mm in length and 38.12 mm in width (Figure 381).

Use-wear

Wear consists of generalized abrasive directional wear with the beginnings of microplating (Figure 382).



Figure 380. The obverse and reverse sides of Artifact 053.

3 YE 0948
053
Obverse Side

Proximal



Distal

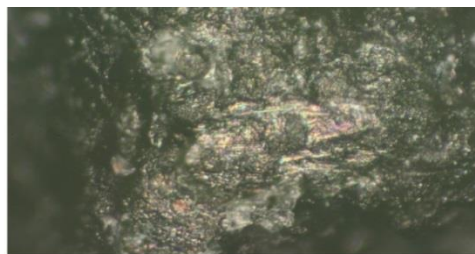
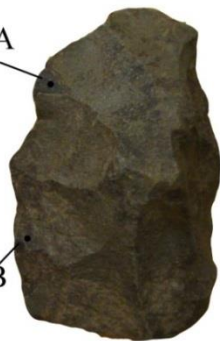


Figure 381. Casting location on the obverse side of Artifact 053.

053
Obverse Side

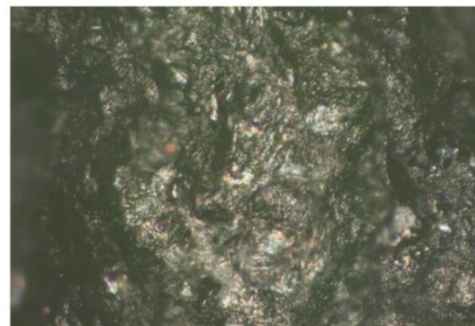
A-A

A-B



.01 mm

A-A 100x



.01 mm

A-B 100x

Figure 382. Wear on the obverse side of Artifact 053, Locations A-A and A-B. A-A shows wear which is additive and directional with light striations. A-B shows generalized abrasion.

Artifact 054

Artifact 054 is a piece of pottery which was accidentally combined in this collection. The sherd is a rim piece with grit temper and has incising on the interior and possibly has some form of slip present.

Artifact 055

Artifact 055 is a chunky double bitted tool with little edge work placed in the practice piece or toy category (Figure 383). The tool is made from sandstone with numerous step fractures with no obvious macro wear seen. There is some evidence of a hafting portion, although the edges are not clearly defined and smoothing and grinding cannot be seen. Artifact 055 weighs 181.4 grams with a length of 97.5 mm, a maximum width of 71.4 mm and a thickness of 19.1 mm.

Casting

Two casts were produced from Artifact 055, a proximal (D) and a haft (F), both from the reverse side of the tool. Cast # 91, the reverse proximal, was created out of Batch 5 and measures 30.08 mm in length and 41.68 mm in width. Cast #92, the reverse haft, was taken from Batch 9 and measures 66.79 mm in length and 35.76 mm in width (Figure 384).

Use-wear

Wear consists of generalized abrasion with the beginnings of additive wear (Figure 385).



Figure 383. The obverse and reverse sides of Artifact 055.

3 YE 0948
055
Reverse Side
Proximal

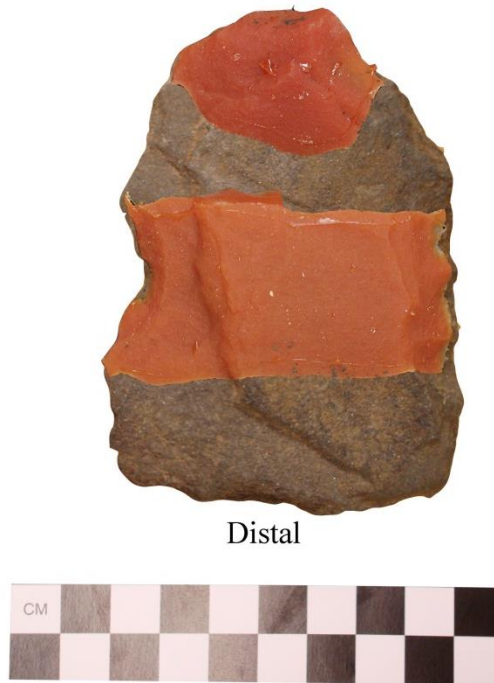


Figure 384. Casting locations on the reverse side of Artifact 055.

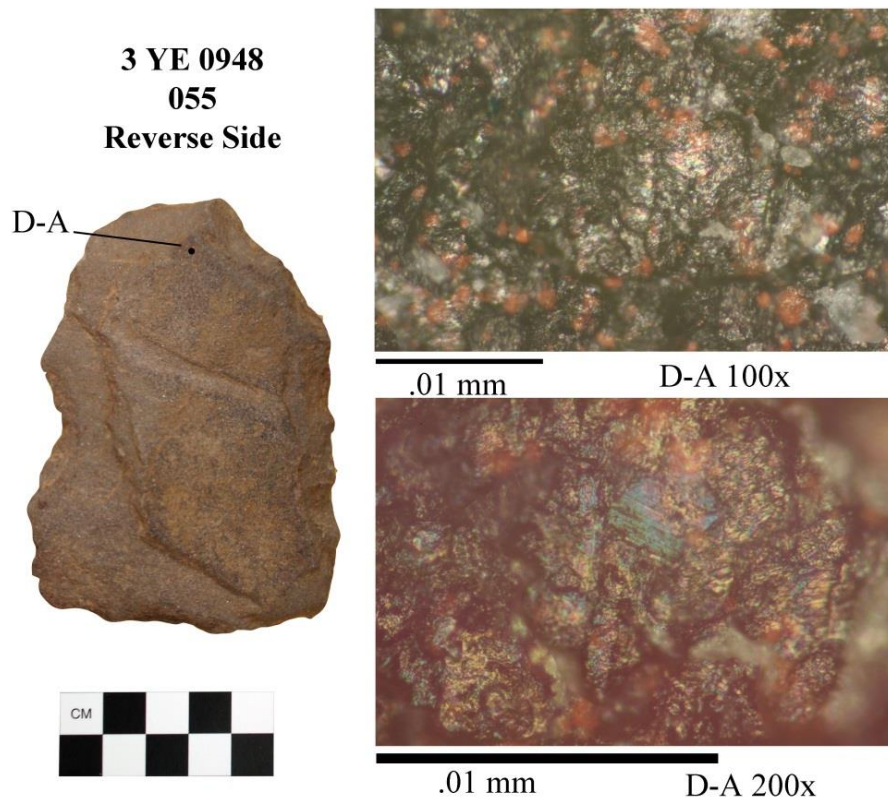


Figure 385. Bit edge wear on the reverse side of Artifact 055, Location D-A, showing generalized abrasion and the beginnings of additive wear.

Artifact 056

Artifact 056 is a laterally broken portion of a double bitted tool made of silicified sandstone (Figure 386). There is a clearly defined hafting portion, although the hafting edge has little grinding or smoothing present. The edges which are present are poorly defined and show little evidence of use. Artifact 056 weighs 192.4 grams with a length of 142.5 mm, a width of 45.1 mm and a thickness of 21.3 mm.

Casting

Cast #93 was the only cast to be taken from Artifact 056. Created from Batch 1, it was taken from the obverse hafting (C) portion of the tool. It measures in at 24.78 mm in length and 44.14 mm in width (Figure 387).

Use-wear

Wear consists of generalized directional abrasive wear (Figure 388).

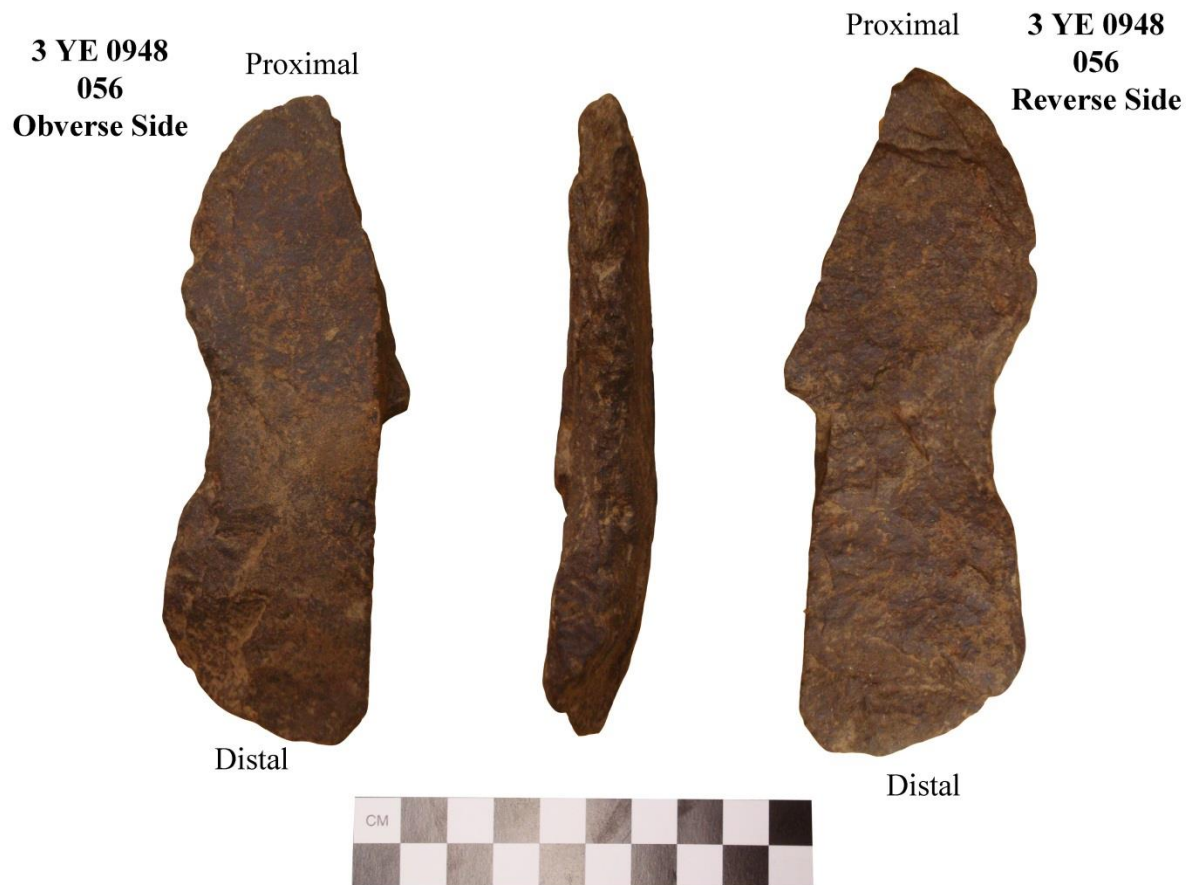


Figure 386. The obverse and reverse side of Artifact 056.

3 YE 0948
056
Obverse Side

Proximal



Distal

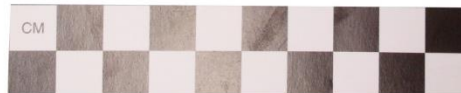


Figure 387. Casting location on the obverse side of Artifact 056.

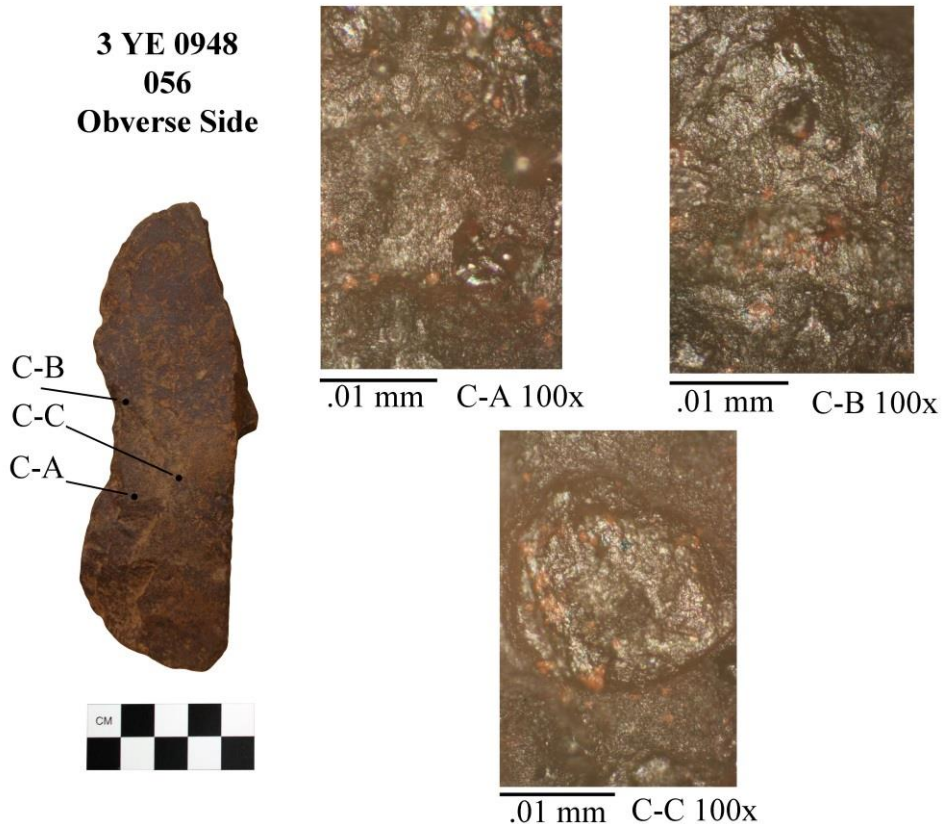


Figure 388. Hafting wear on the obverse side of Artifact 056, Location C-A, C-B and C-C, showing generalized abrasion.

Artifact 057

Artifact 057 is the fractured hafting portion of a double bitted tool made of silicified sandstone (Figure 389). Both proximal and distal edges have been lost, but polish can be seen in the hafting areas. There is a large step fracture on one side of the tool. Artifact 057 weighs 129.2 grams with a length of 69.9 mm, a maximum width of 60.0 mm and a thickness of 22.1 mm.

Casting

Artifact 057 had only one cast taken, Cast #94. Produced from Batch 8, it is the obverse hafting side of the tool. The cast's dimensions are 50.64 mm in length by 41.25 mm in width (Figure 390).

Use-wear

Hafting wear consists of microplating wear with striations running perpendicular to the tool's longitudinal axis. General abrasive wear can also be seen (Figures 391-392).



Figure 389. The obverse and reverse sides of Artifact 057.

**3 YE 0948
057
Obverse Side**

Proximal



Distal

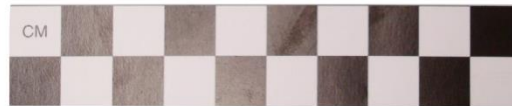


Figure 390. Casting location on the obverse side of Artifact 057.

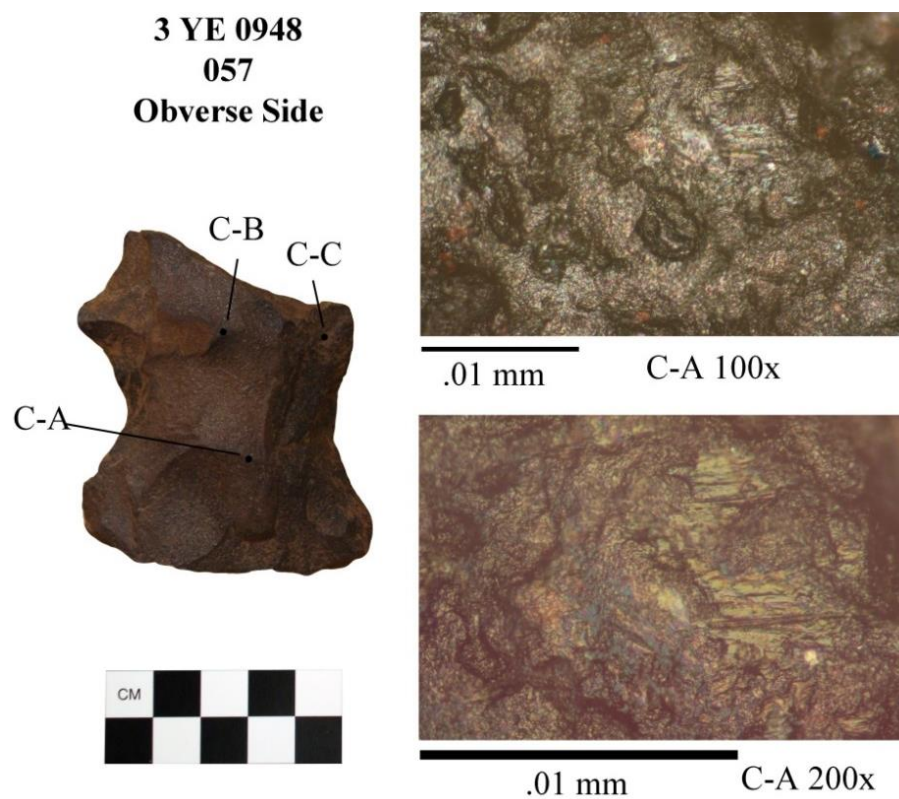


Figure 391. Hafting wear on the obverse side of Artifact 057, Location C-A, showing both additive and abrasive wear with directional striations running perpendicular to the longitudinal axis of the tool.

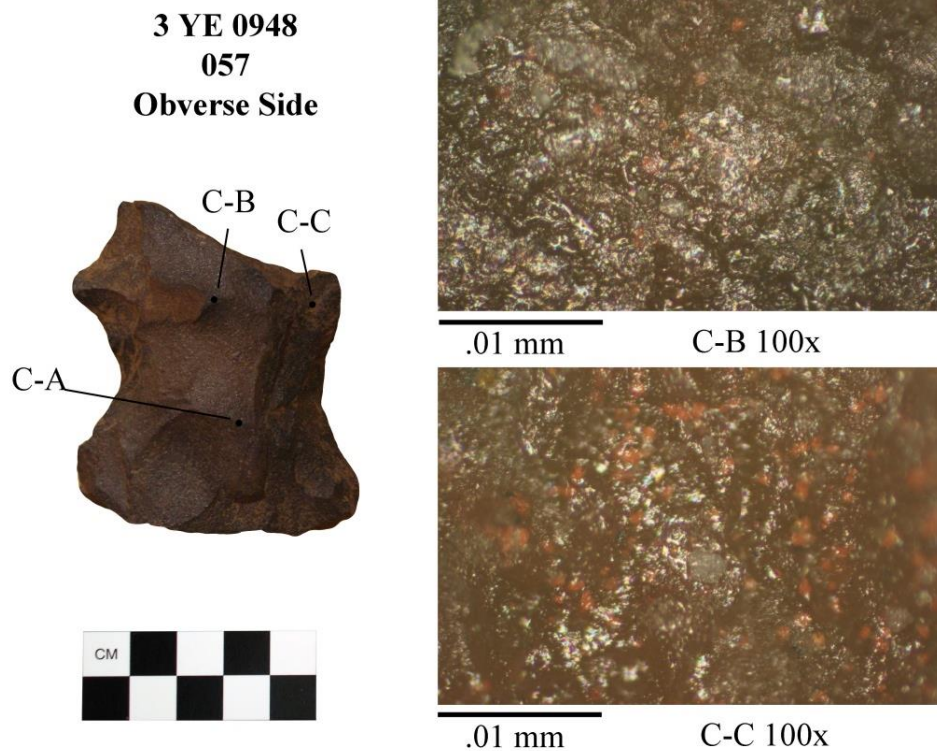


Figure 392. Hafting wear on the obverse side of Artifact 057, Locations C-B and C-C, showing slight casting error in the form of oil (C-B) and light abrasive wear on C-B and C-C.

Artifact 058

Artifact 058 is a broken half of a double bitted tool made of silicified sandstone (Figure 393). A small portion of the hafting area is intact. The edge of this tool is rounder than many of the others and is considerably thicker than the other tools of the same size. A small amount of wear can be seen in the hafting area. The edge has been significantly ground down and smoothed. Both the edge of the tool and the edges around the broken area have been ground down to a smooth surface. This tool was likely damaged during a recycling attempt. Artifact 058 weighs 104.0 grams with a length of 53.6 mm, a width of 57.7 mm and a maximum thickness of 28.6 mm.

Casting

Only one cast was taken from Artifact 058, a reverse proximal (D) produced from Batch 4. This is Cast #95 and measures in at 30.76mm in length and 44.74 mm in width (Figure 394).

Use-wear

Wear consists of generalized abrasion with the beginnings of microplating wear (Figure 395).



Figure 393. The obverse and reverse sides of Artifact 058.

3 YE 0948
058
Reverse Side

Proximal



Distal



Figure 394. Casting location on the reverse side of Artifact 058.

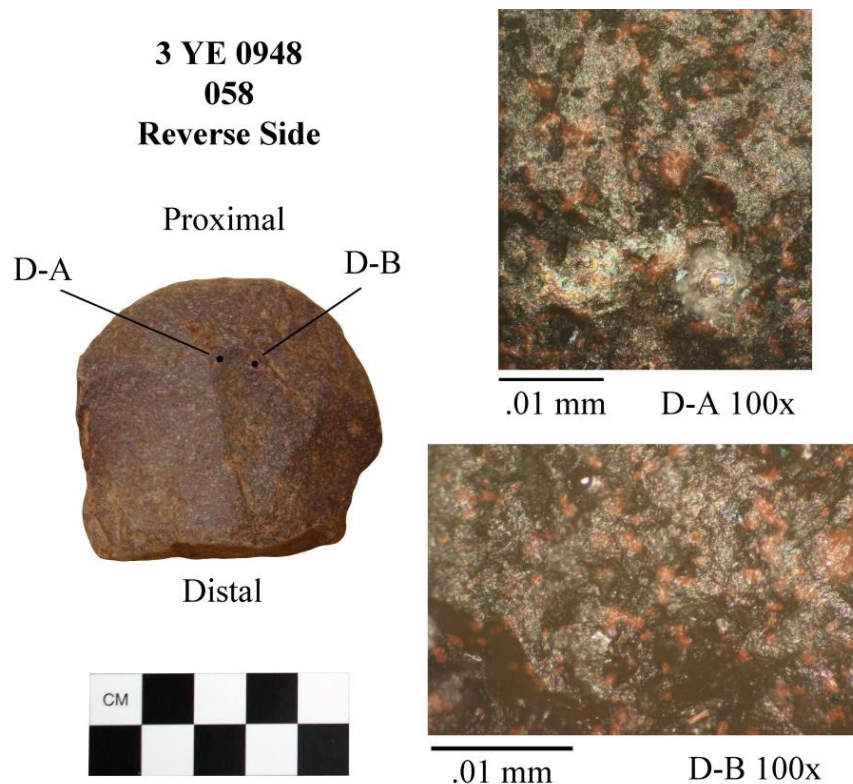


Figure 395. Bit edge wear on the reverse side of Artifact 058, Location D-A and D-B, showing generalized abrasive wear, most likely caused during modification of the tool, where the edge was ground prior to attempt re-sharpening.

Artifact 059

Artifact 059 is the broken half of a double bitted tool made of silicified sandstone (Figure 396). The hafting section and the proximal edge are intact. There is evidence of hafting polish present and the edges are sharp with little grinding present. The tool appears to have been damaged during use, due to the bending fracture where the tool failed. The proximal edge had a large flake removed, possibly at the time of tool breakage. This flake removal would have affected the use of the tool, most likely causing the rejection of the tool. After the initial breakage of the tool, it was potentially modified into a wedge form tool. There is evidence of impact and grinding on the broken edge of the artifact. Artifact 059 weighs 103.3 grams with a length of 68.2 mm, a maximum width of 56.0 mm and a thickness of 22.6 mm.

Casting

Cast #96 is the only cast produced from Artifact 059. Created from Batch10, it was taken from the hafting (F) portion on the reverse side of the tool. The measurements for this cast are 47.78 mm in length and 32.96 mm in width (Figure 397).

Use-wear

Hafting wear consists of heavy microplating with few multi-directional striations, some of which are partially filled in (Figure 398).

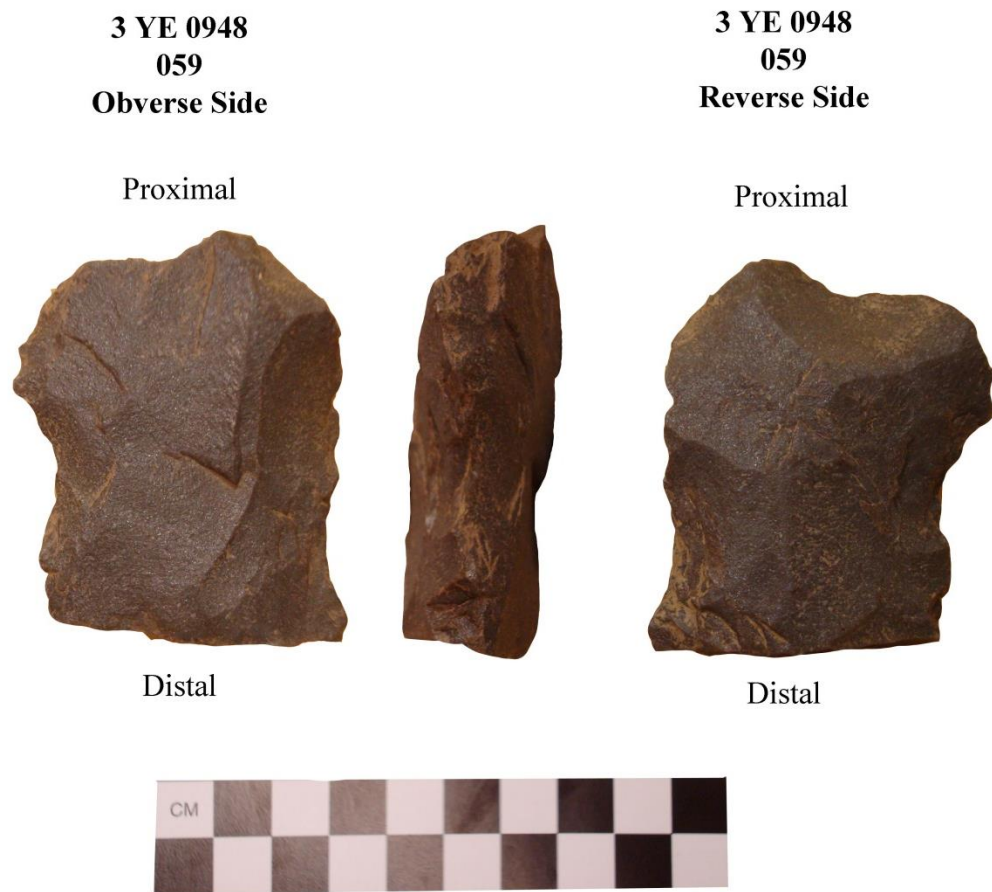


Figure 396. The obverse and reverse sides of Artifact 059.

**3 YE 0948
059
Reverse Side**

Proximal



Distal



Figure 397. Casting location on the reverse side of Artifact 059.

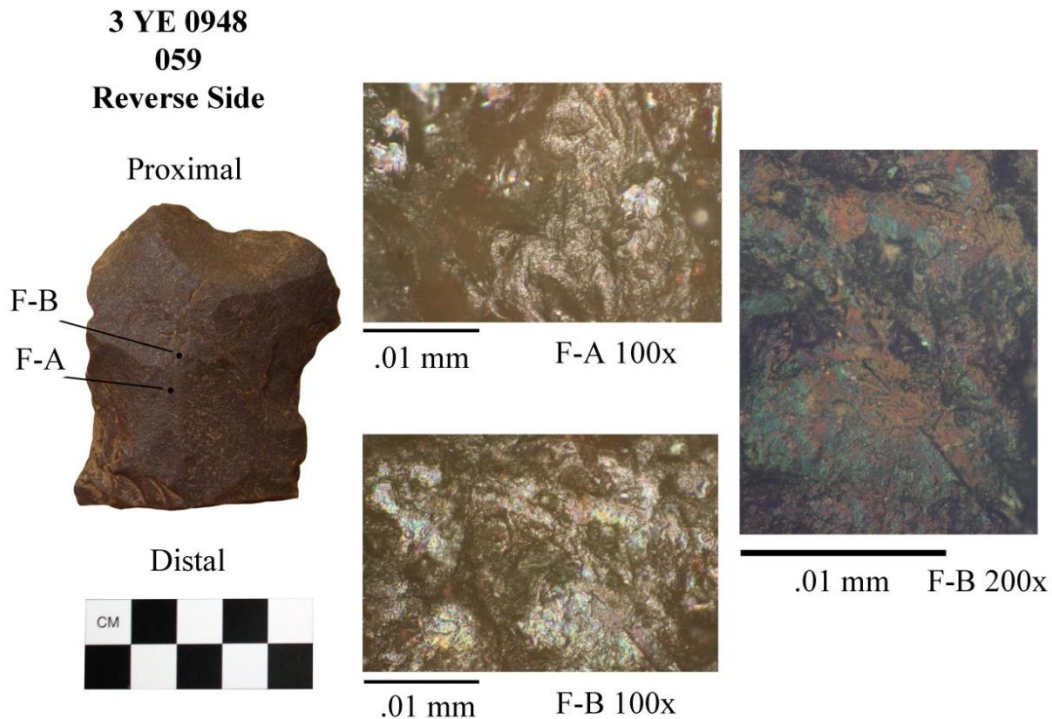


Figure 398. Hafting wear on the reverse side of Artifact 059, showing additive and abrasive wear with few multi-directional striations.

Artifact 060

Artifact 60 is the broken half of a double bitted tool made of sandstone (Figure 399). The proximal edge and a portion of the hafting area are intact. The hafting portion is fairly pronounced and there is slight rounding of the proximal edge. The damaged edge does not show evidence of wear or damage and the tool was most likely rejected when damage occurred. Tool damage most likely occurred during use, due to the bending fracture at the damaged end. While tool edge shows considerable rounding, there is not macro evidence of polishing. Artifact 060 weighs 128.9 grams with a length of 66.8 mm, a width of 84.7 mm and a maximum thickness of 17.6 mm.

Casting

Two casts were taken from Artifact 060, a proximal (D) and a haft (F), both taken from the reverse side of the tool. Cast # 97, the reverse proximal, was produced from Batch 3 and

measures in a 62.33 mm in length and 32.14 mm in width. Cast #98, the reverse haft, was also created out of Batch 3 and its dimensions are 69.12 mm in length and 25.12 mm in width (Figure 400).

Use-wear

Both bit and haft wear consist of light generalized abrasion with the beginnings of microplating wear (Figures 401-402).



Figure 399. The obverse and reverse sides of Artifact 060.

**3 YE 0948
060
Reverse Side**

Proximal



Distal



Figure 400. Casting location on the reverse side of Artifact 060.

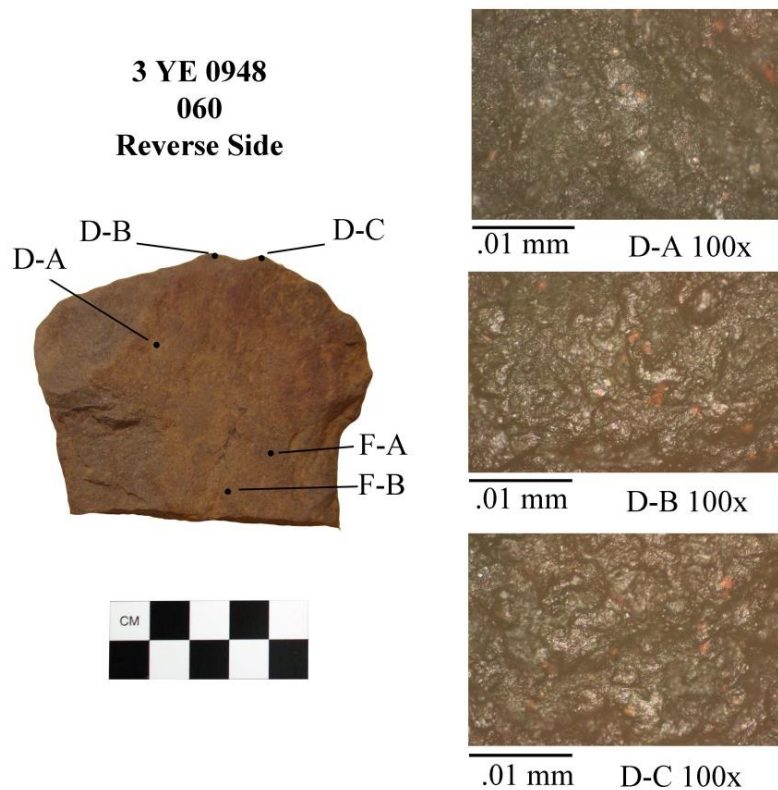


Figure 401. Bit edge wear on the reverse side of Artifact 060, Locations D-A, D-B and D-C, showing light abrasion and the beginning of additive wear.

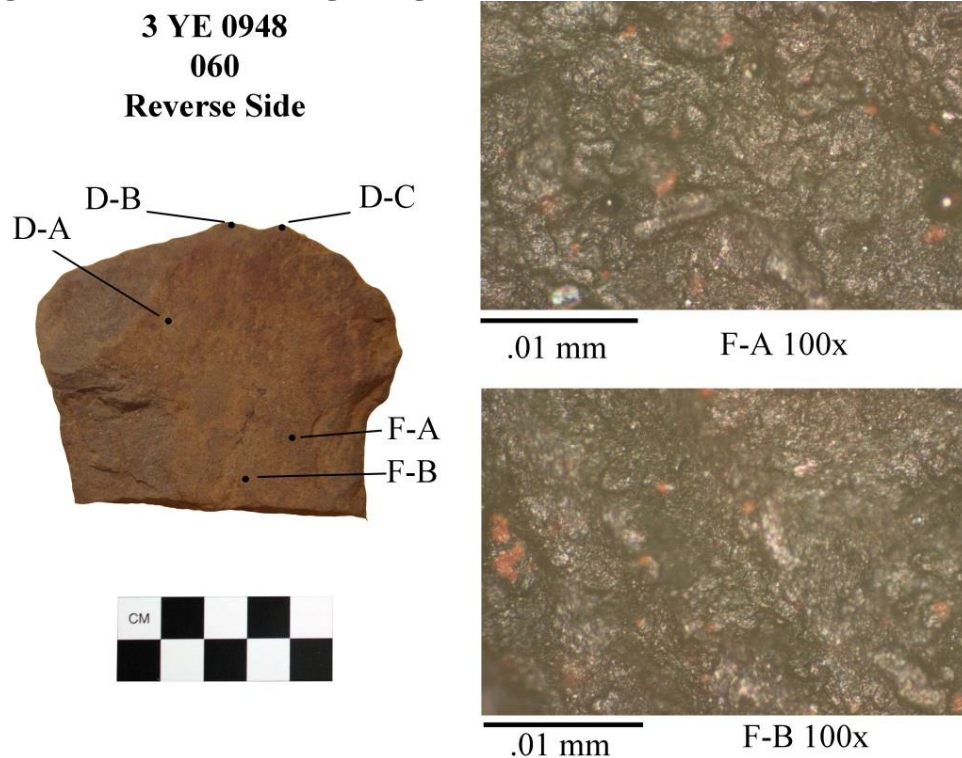


Figure 402. Hafting wear on the reverse side of Artifact 060, Locations A-F and F-B, showing generalized abrasion.

Artifact 061

Artifact 061 is a complete double bitted tool made of silicified sandstone (Figure 403). Both edges and the hafting portion are intact. The bits are triangular in shape with little edge smoothing or grinding present. The tool may be newly knapped with minimal use. Artifact 061 weighs 143.1 grams with a length of 110.3 mm, a maximum width of 65.1 mm and a thickness of 20.8 mm.

Casting

Three casts were taken from Artifact 061, on obverse proximal (A), an obverse distal (B) and a reverse haft (F). All three casts were produced from Batch 4. Cast #99, the obverse proximal, measures in at 38.7 mm in length by 32.82 mm in width. Cast #100, the obverse distal, has 40.07 mm in length and 32.55 mm in width for its dimensions. Cast #101, the reverse haft is 41.02 mm in length and 35.41 mm in width (Figure 404).

Use-wear

Bit edge wear shows heavy microplating wear with multi-directional striations some of which are partially filled in. The majority of the striations run perpendicular to the bit edge and there is the presence of some generalized abrasion. Hafting wear consists of generalized abrasion with some microplating (Figures 405-408).



Figure 403. The obverse and reverse sides of Artifact 061.

3 YE 0948
061
Reverse Side

Proximal



Distal



Figure 404. Casting locations on Artifact 061.

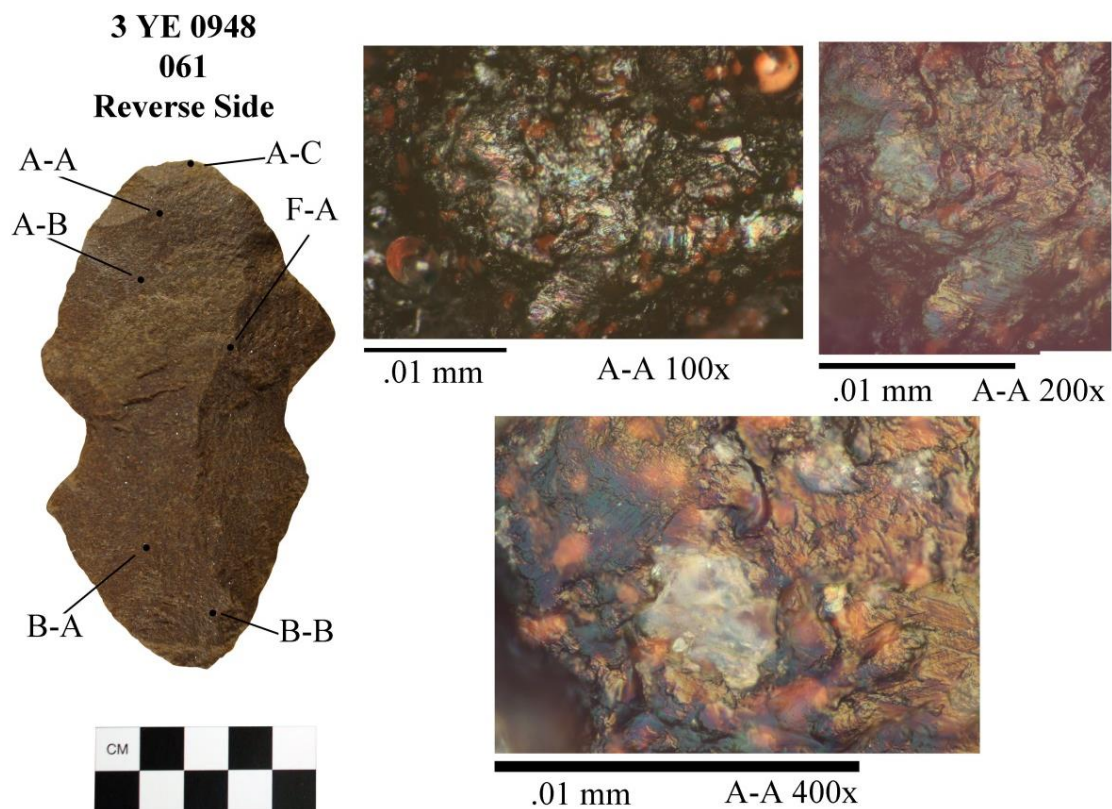


Figure 405. Bit edge wear on the reverse side of Artifact 061, Location A-A, showing heavy microplating and overlapping multidirectional striations.

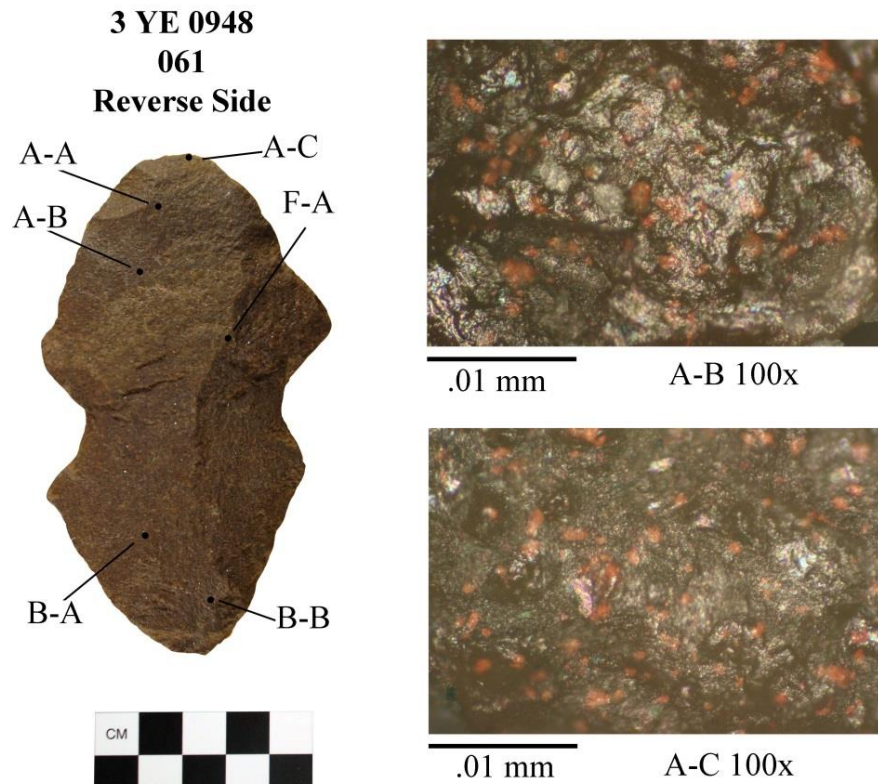


Figure 406. Bit edge wear on the reverse side of Artifact 061, Locations A-B and A-C, showing generalized abrasion and the beginnings of additive wear.

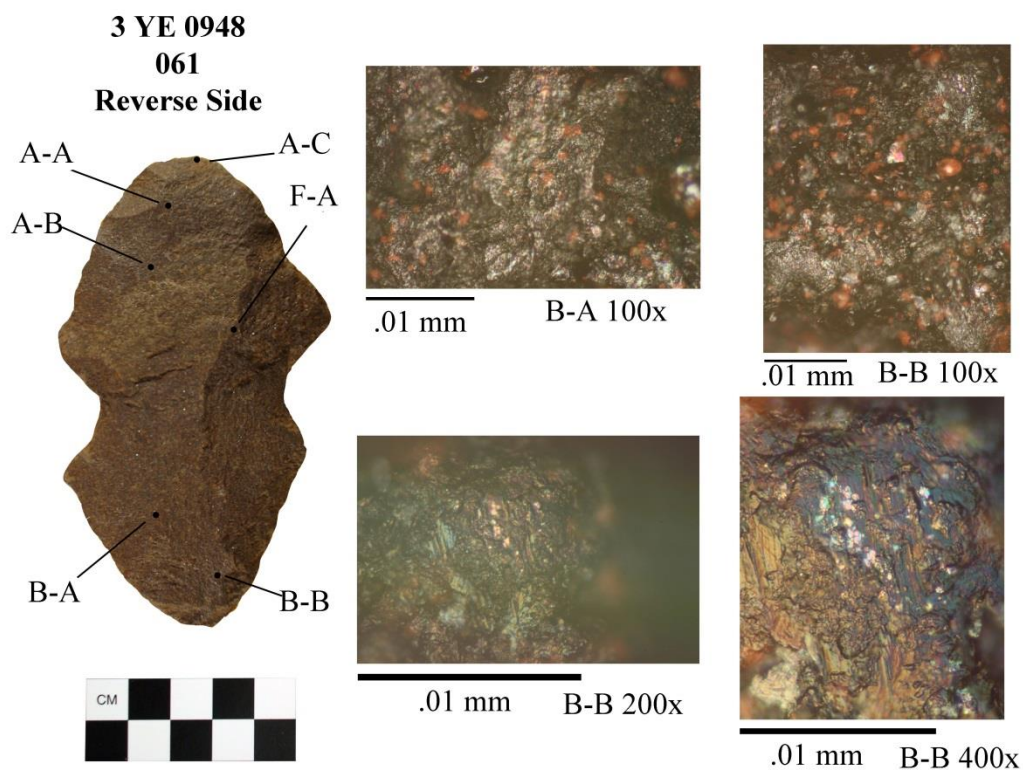


Figure 407. Bit edge wear on the reverse side of Artifact 061, Locations B-A and B-B, showing additive wear and striations running perpendicular to the bit edge.

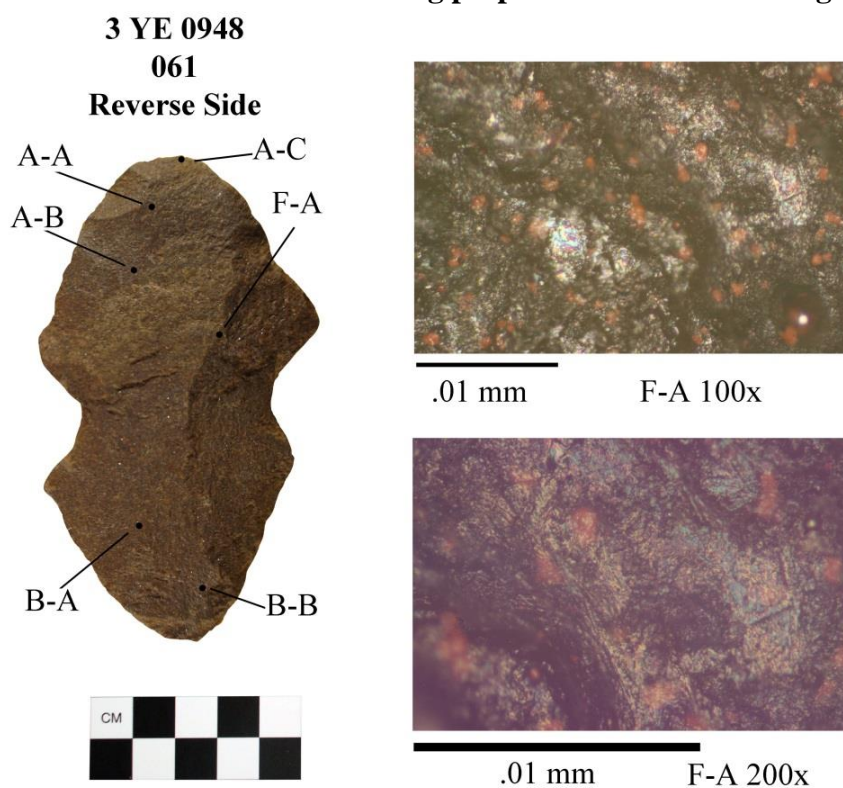


Figure 408. Hafting wear on the reverse side of Artifact 061, Location F-A, showing additive wear and light striations.

Artifact 062

Artifact 062 is a roughly hewed double bitted tool made of sandstone (Figure 409). Edges are not clearly defined and the artifact was placed in the practice piece or toy category. Artifact 062 is in the early stages of production, the hafting portion is defined, but the edges are roughly knapped out and have no defining or grinding on either. Artifact 062 weighs a dense 354.1 grams with a length of 135.9 mm, a width of 90.0 mm and a thickness of 20.4 mm.

Casting

Cast #102 is the only cast which was taken from Artifact 062. Created from Batch12, it was taken from the obverse haft (C) of the tool. The dimensions of this cast are 84.65 mm in length and 33.4 mm in width (Figure 410).

Use-wear

Hafting wear consists of generalized abrasion with the beginnings of microplating (Figure 411).

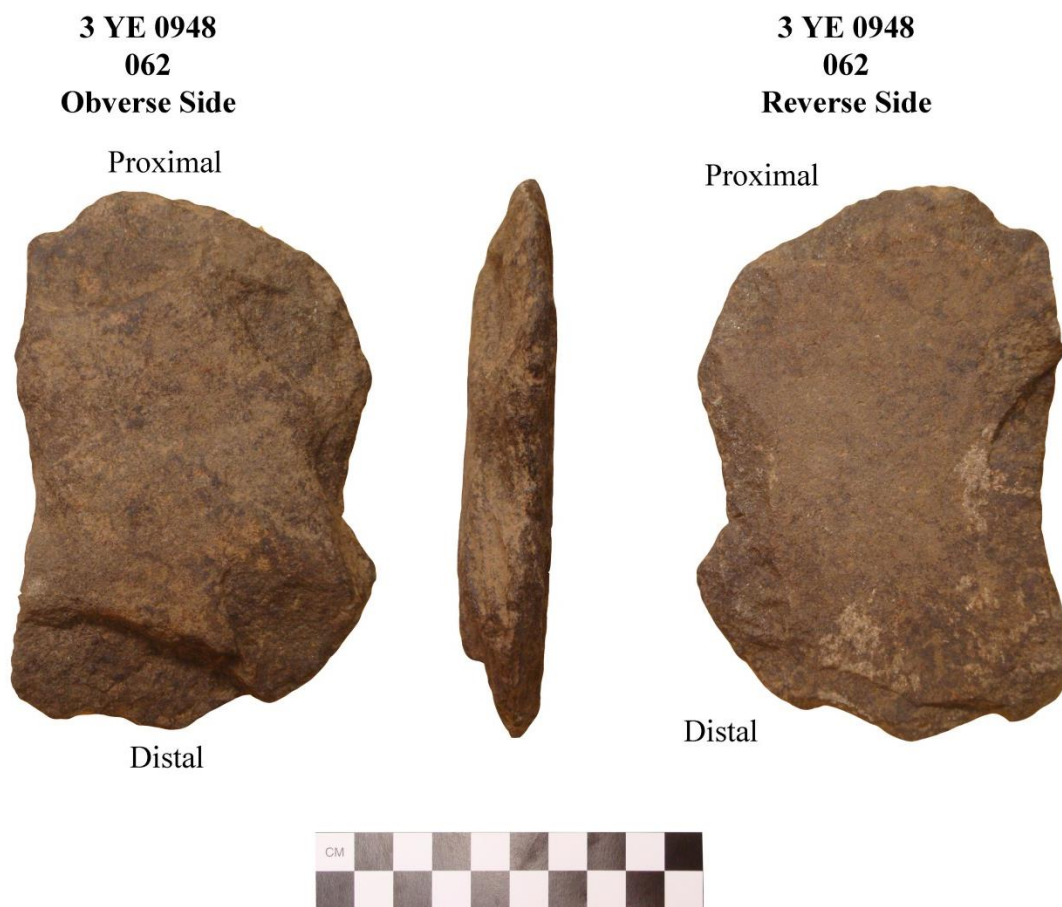


Figure 409. The obverse and reverse sides of Artifact 062.



Figure 410. Casting location on Artifact 062.

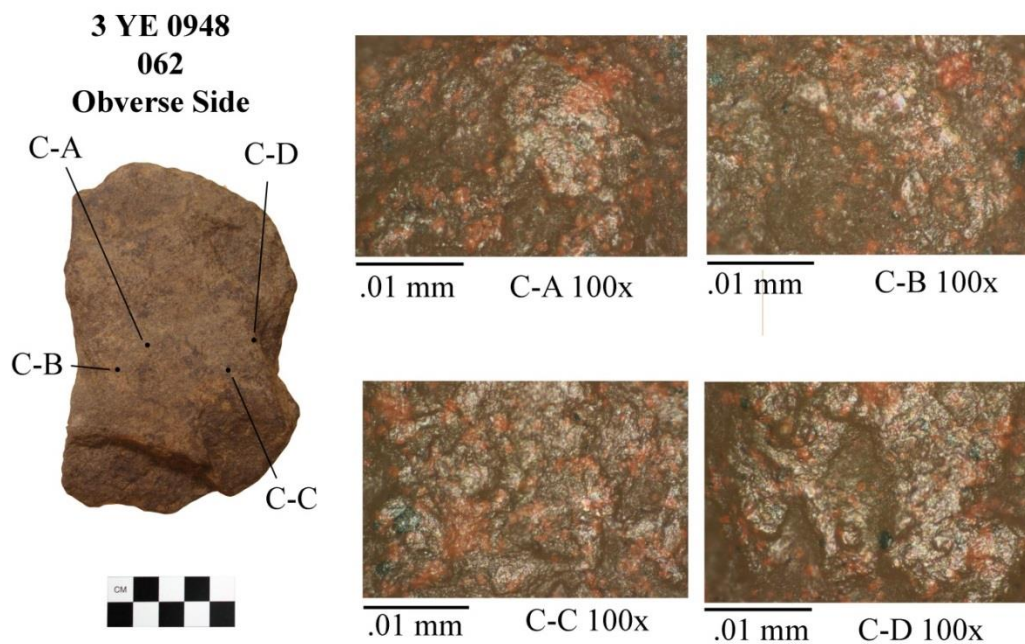


Figure 411. Hafting wear on the obverse side on Artifact 062, Locations C-A, C-B, C-C and C-D, showing light abrasion and the beginnings of additive wear.

Artifact 063

Artifact 063 is the broken edge of a tool made from slate (Figure 412). This tool is a fragmented portion of a double bitted tool; the hafting portion of the tool is still intact. The edges are ground heavily and are quite smooth. Artifact 063 weighs 86.1 grams with a length of 67.2 mm, a maximum width of 70.8 mm and a thickness of 17.5 mm.

Casting

Only one cast, Cast #103, was taken from Artifact 063. Representing the reverse proximal (D), this cast was produced from Batch 2 and measures 33.98 mm in length and 56.24 mm in width (Figure 413).

Use-wear

Bit wear consists of generalized abrasion with the beginnings of microplating wear (Figure 414).



Figure 412. The obverse and reverse side of Artifact 063.

3 YE 0948
063
Reverse Side

Proximal

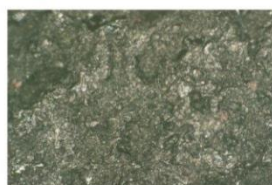
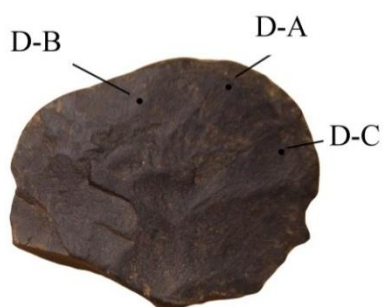


Distal



Figure 413. Casting location on Artifact 063.

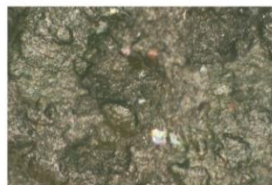
3 YE 0948
063
Reverse Side



.01 mm D-A 100x



.01 mm D-B 100x



.01 mm D-C 100x

Figure 414. Bit edge wear on the reverse side on Artifact 063, Locations D-A, D-B and D-C, showing generalized abrasion and the beginnings of additive wear.

Artifact 064

Artifact 064 is a broken edge of a tool made of sandstone (Figure 415). There is only a small portion of the tool left and the original form cannot be determined. While there is some edge rounding, there are significant issues with it being a tool, such as a large step fracture which would have stopped tool function. Artifact 064 weighs 102.4 grams with a length of 48.4 mm, a width of 78.0 mm and a thickness of 20.6 mm.

Casting

Cast # 104 was the only cast taken from Artifact 064. Created from Batch 3, this cast is a copy of the obverse proximal (A) side of the tool. The dimensions of this cast measures 32.95 mm in length by 43.41 mm in width (Figure 416).

Use-wear

Bit edge wear consists of generalized abrasion with the possible beginnings of microplating (Figure 417).

**3 YE 0948
064
Obverse Side**

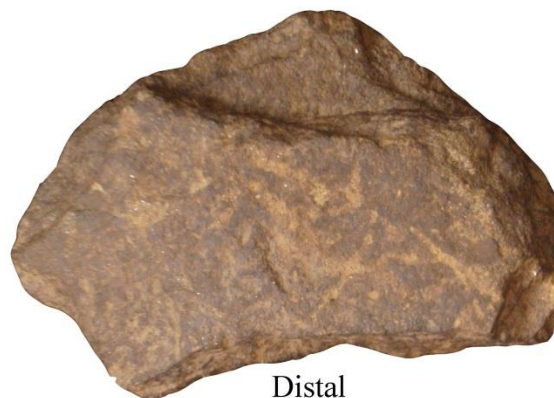
Proximal



Distal

**3 YE 0948
064
Reverse Side**

Proximal



Distal



Figure 415. The obverse and reverse sides of Artifact 064.

**3 YE 0948
064
Obverse Side**

Proximal



Distal



Figure 416. Casting location on Artifact 064.

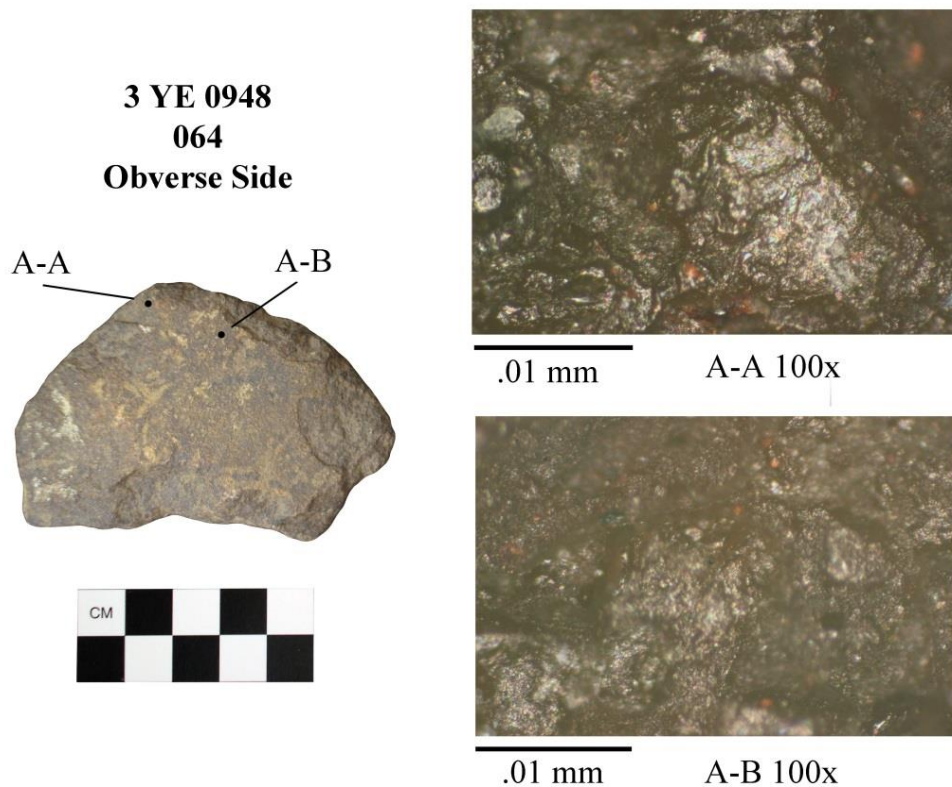


Figure 417. Bit edge wear on the obverse side of Artifact 064, Locations A-A and A-B, showing generalized abrasion and the beginnings of additive wear.

Artifact 065

Artifact 065 is complete double bitted tool with some damage and extremely heavy wear (Figure 418). Made of sandstone, this tool has a very rounded proximal edge which has been significantly ground down and smoothed. The tool has potential for wear on the hafting portion. The distal edge broke off at some point possibly due to historic plowing. Artifact 065 weighs 156.8 grams with a length of 89.5 mm, a maximum width of 66.7 mm and a thickness of 18.0 mm.

Casting

Artifact 065 had two casts produced, a proximal (A) and a haft (C), both from the obverse side of the tool. Cast #105, the obverse proximal, was created out of Batch 12 and measures

22.18 mm in length and 44.31 mm in width. Cast #106, the obverse haft, was taken from Batch 10 and measures 62.88 mm in length and 29.76 mm in width (Figure 419).

Use-wear

Wear on this tool consists of generalized abrasion (Figure 420).

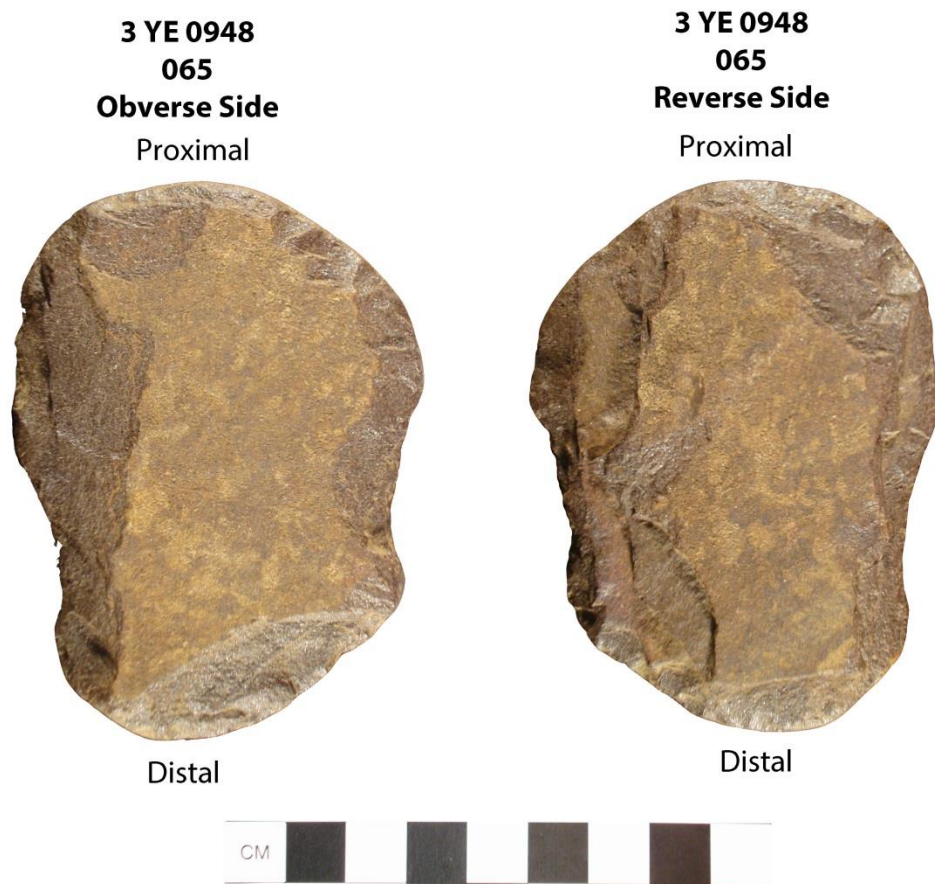


Figure 418. The obverse and reverse side of Artifact 065.

3 YE 0948
065
Obverse Side
Proximal



Distal



Figure 419. Casting location on Artifact 065.

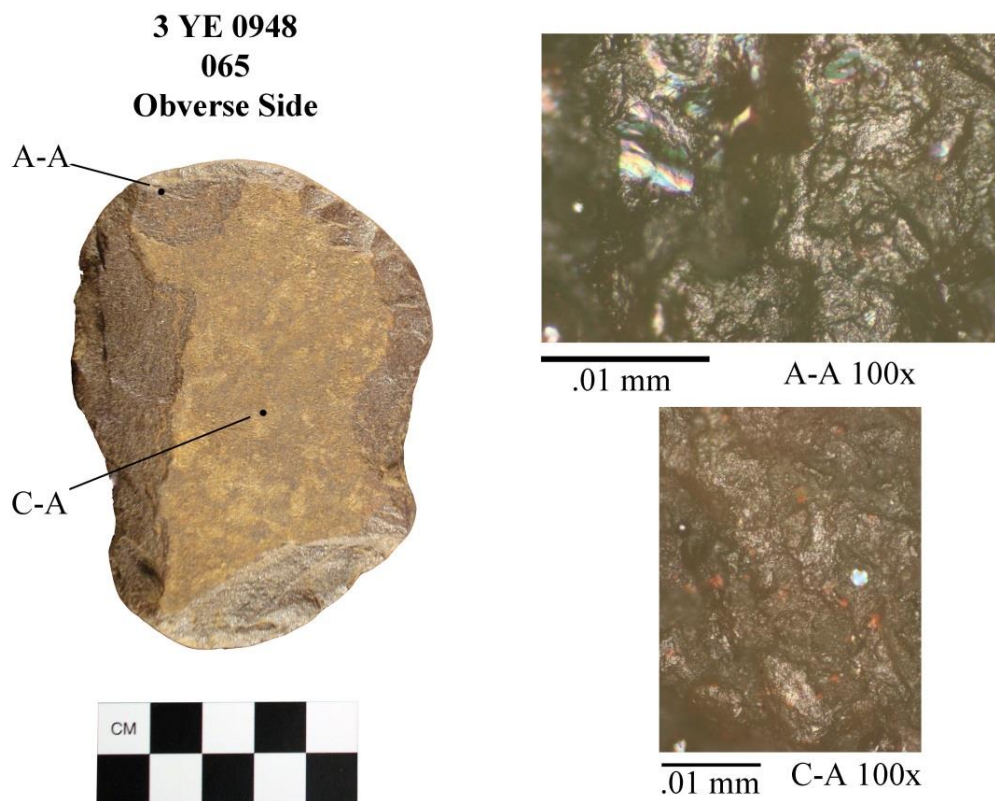


Figure 420. Bit and hafting wear on the obverse side of Artifact 065, Locations A-A and C-A, both locations show abrasive wear.

Artifact 066

Artifact 066 is the broken half of a double bitted tool (Figure 421). Tool edge is rather sharp with little smoothing or grinding. Tool breakage most likely occurred during use, probably due to a twisting of the tool when impact occurred. Artifact 066 is made of silicified sandstone and contains numerous inclusions of quartzite. Artifact 066 weighs 93.0 grams with a length of 61.9 mm, a width of 74.7 mm and a thickness of 18.4 mm.

Casting

Only one cast was taken from Artifact 066, a reverse proximal (D). Cast #107 was produced from Batch 5 and measures in at 35.08 mm in length by 50.52 mm in width (Figure 422).

Use-wear

Wear on the bit consists of generalized abrasion and light microplating (Figure 423).



Figure 421. The obverse and reverse sides of Artifact 066.

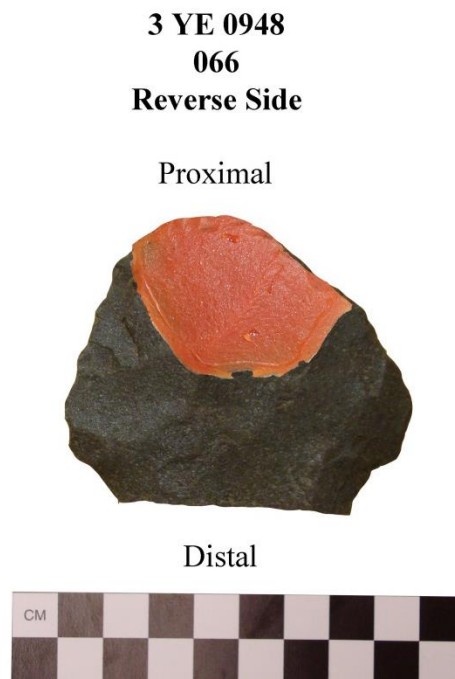


Figure 422. Casting location on Artifact 066.

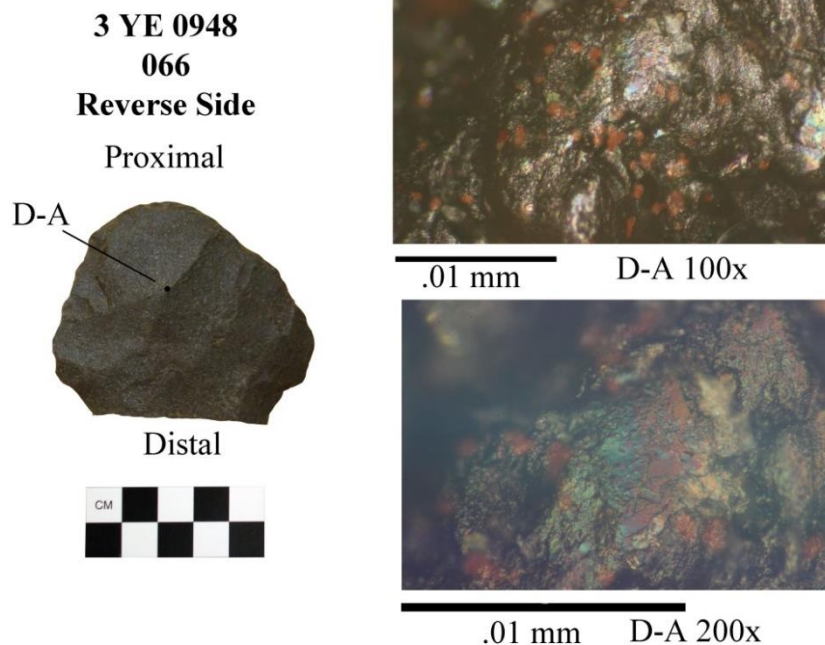


Figure 423. Bit edge wear on the reverse side of Artifact 066, Location D-A, showing microplating and light abrasion.

Artifact 067

Artifact 067 is a complete double bitted tool with rounded edges (Figure 424). Made of silicified sandstone, there is hafting polish seen and light grinding around the tool edges.

Artifact 067 weighs 88.9 grams with a length of 93.9 mm, a width of 51.8 mm and a maximum thickness of 17.3 mm.

Casting

A total of three casts were created from Artifact 067, a proximal (A), a distal (B) and a haft (C), all of which were taken from the obverse side of the tool. Cast #108, the obverse proximal was created from Batch 4 and measures in at 27.57 mm in length and 38.29 mm in width. Cast # 109, the obverse distal was produced from Batch 5 and measures 29.89 mm in

length and 33.22 mm in width. Cast # 110, the obverse haft was also taken from Batch 5 and its dimensions are 34.5 mm in length by 36.8 mm in width (Figure 425).

Use-wear

Wear on this tool consists of mainly generalized abrasion with a couple locations showing the beginnings of microplating wear. Hafting wear also shows generalized abrasion (Figures 426- 429).



Figure 424. The obverse and reverse sides of Artifact 067.

**3 YE 0948
067
Obverse Side**

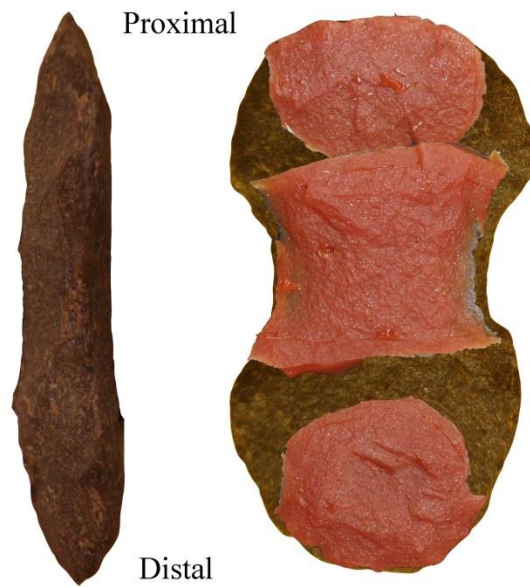


Figure 425. Casting location on Artifact 067.

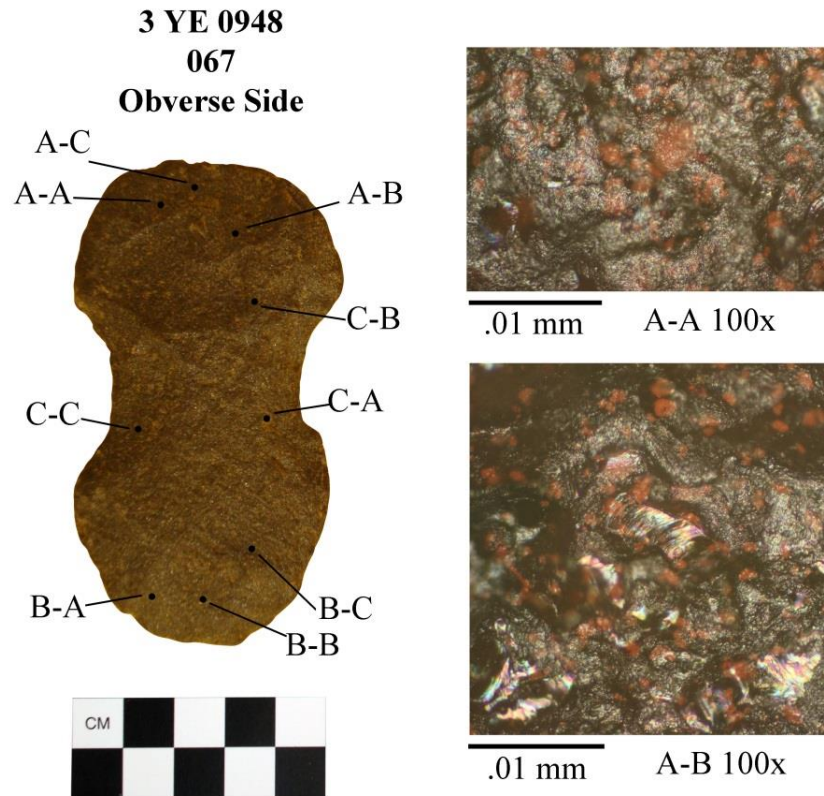


Figure 426. Bit edge wear on the obverse side of Artifact 067, Locations A-A and A-B, showing generalized abrasive wear.

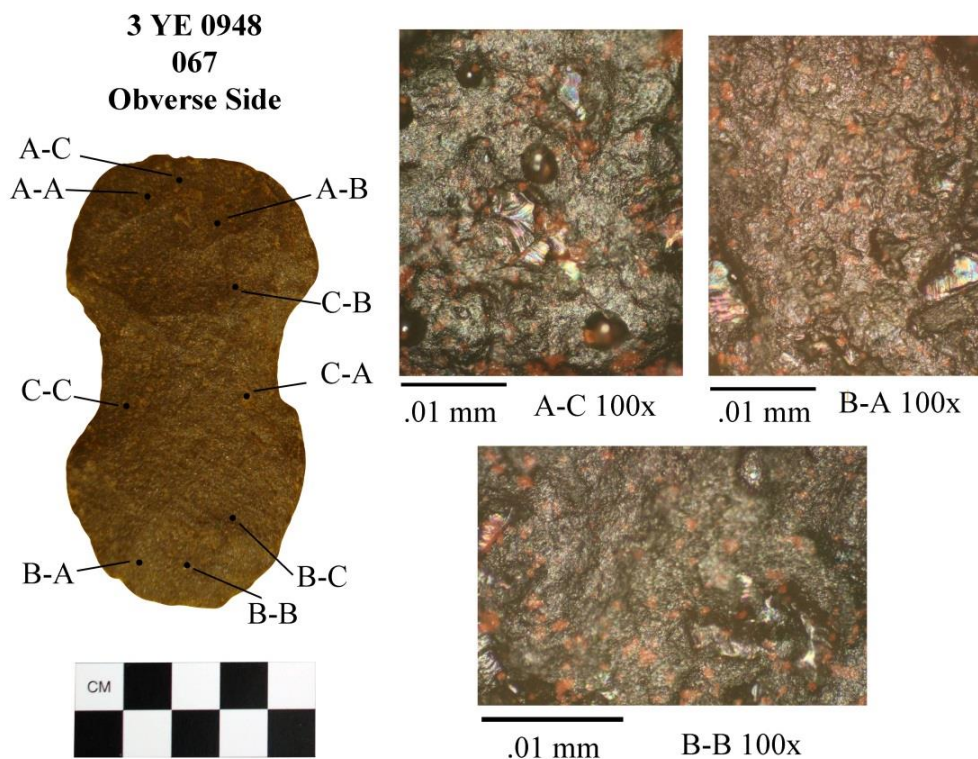


Figure 427. Bit edge wear on the obverse side of Artifact 067, Locations A-C, B-A and B-B, showing generalized abrasion and the beginnings of additive wear.

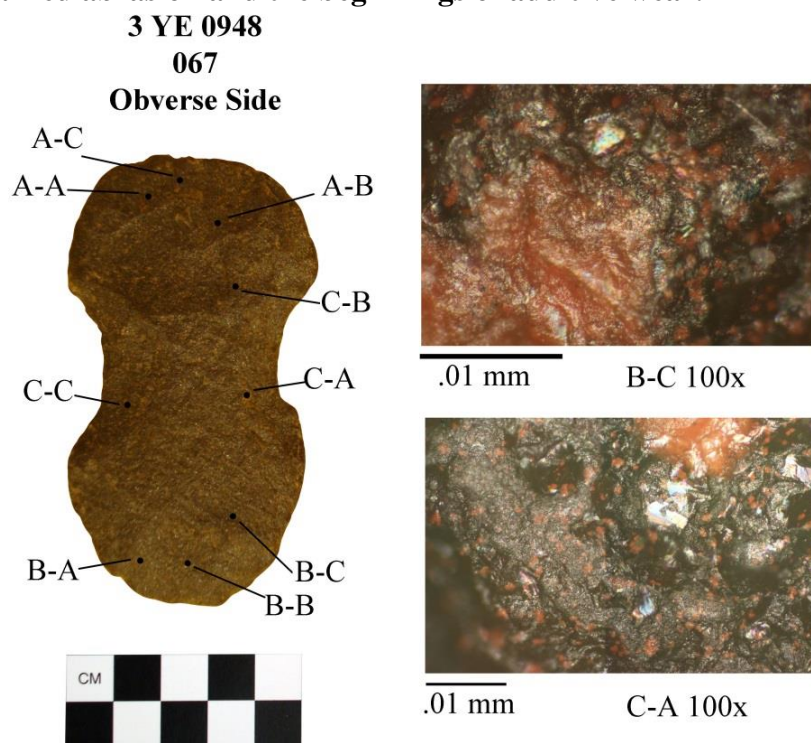


Figure 428. Bit edge and hafting wear on the obverse side of Artifact 067, Locations B-C and C-A , showing generalized abrasion and the beginnings of additive wear.

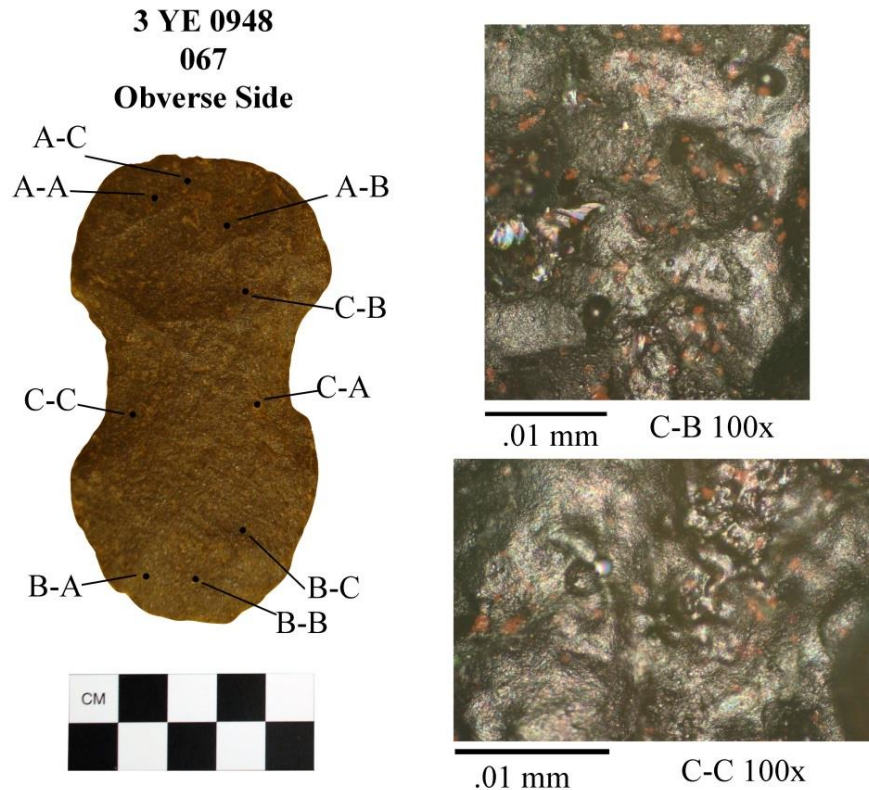


Figure 429. Hafting wear on the obverse side of Artifact 067, Locations C-B and C-C, showing generalized abrasion and cast error in the form of oil/grease.

Artifact 068

Artifact 068 is a chunky tool made from sandstone in the rough form of a double bitted tool (Figure 430). There is a hafting portion, but it does not appear the tool has actually been hafted. The proximal end has been modified to an edge, while the distal end does not look as though an edge was attempted. This tool is representative of the practice piece or toy category. Artifact 068 weighs 271.3 grams with a length of 99.8 mm, a width of 72.9 mm and a maximum thickness of 33.8 mm.

Casting

Two casts were produced from Artifact 068, a proximal (D) and a haft (F), both of which were taken from the reverse side of the tool. Cast #111, the reverse proximal was created out of

Batch 2 and measures 26.94 mm in length and 43.7 mm in width. Cast # 112, the reverse haft, was produced out of Batch 7 and its dimensions are 50.93 mm in length and 32.93 mm in width (Figure 431).

Use-wear

The little wear which is seen on this tool consists of generalized abrasion (Figure 432).



Figure 430. The obverse and reverse sides of Artifact 068.

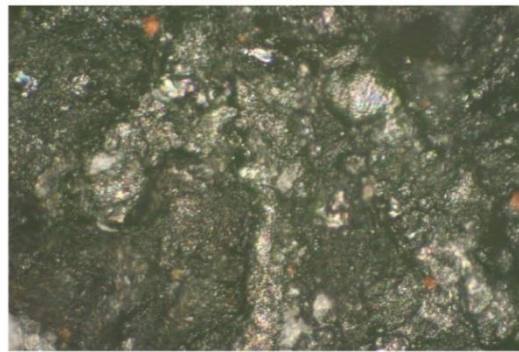
3 YE 0948
068
Reverse Side
Proximal



Distal

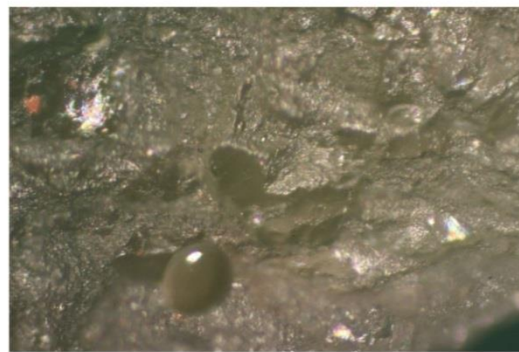


Figure 431. Casting locations on Artifact 068.



.01 mm

D-A 100x



.01 mm

D-B 100x

Figure 432. Bit edge wear on the reverse side of Artifact 068, Location D-A and D-B, showing light abrasion and the beginnings of additive wear. Cast error can be seen in Location D-B in the form of air bubbles.

Appendix 3: Scott County Experimental Replica Collection Catalog

The following is the listing of the entire experimental collection which was created for this project. The experimental collection consisted of 20 tool replicas, although some of the tools were damaged in the production phase and were not utilized in the field. This catalog lists the basic description of each tool, the measurements of all of the tools, the form in which the tool was hafted, and the way in which the tool was planned to be used. How each tool was used in the field is described as well as the benefits or challenges discovered. Images for each replica consist of the individual tools, the hafting for each one and if applicable, images of the tool in use. See Chapter 3 for information on production of the experimental collection.

This section also contains all of the use-wear seen on the experimental collection. Images of all the use-wear and the locations where the use-wear was seen are documented. The analysis of this wear is located in Chapter 4.

Scott County Experimental 01

This tool is a double bitted replica made of silicified sandstone and is the largest in the experimental collection (Figure 433). The tool measures 694.9 gram and is 1780 mm in length by 101.68 mm in width, with a hafting width of 56.35 mm and a maximum thickness of 28.7 mm. Scott County 01 was hafted as an agricultural hoe on a hickory handle with dried willow bark for the hafting (Figure 434). The supportive portion of the handle, where the tool is actually attached and rests on was located on the top of the tool. The addition of a wedge was used on this tool to give a greater hold on the tool and to stretch the binding. Scott County 01 was attached to the longest handle in the experimental collection, allowing the tool to be used as a hoe while the research was standing.

Scott County 01 was first used on March 27th 2013 and worked wonderfully as an agricultural hoe (Figure 435). The weight of the tool made breaking up the soil and any vegetation present quite easy and the length of the tool's handle made it one of the easier replicas in the collection to use. The tool failed where the supportive arm attached to the handle of the tool, due to a fault in the wood itself and not to any of the activities which the tool was utilized for. Both the tool and the willow hafting held up throughout the use. The supportive portion of the handle being located on the top of the tool seemed to give the tool greater strength and stability. The tool was re-attached to a new handle and was used again on April 25th, 2013 and again performed excellently. This tool was capable of creating a small garden in just a few minutes time with little labor required from the individual.

Use-wear

Bit edge wear on Scott County 01 consists of portions of microplating with partially filled in striations and locations of generalized light abrasion. Hafting wear consists of microplating with numerous directional striations running perpendicular to the tool's longitudinal axis (Figures 436-450).



Figure 433. The obverse and reverse sides of Scott County 01.



Figure 434. Experimental tool hafting on Scott County 01, designed for use as an agricultural hoe with willow bark hafting.



Figure 435. Scott County 01 during experimental use.

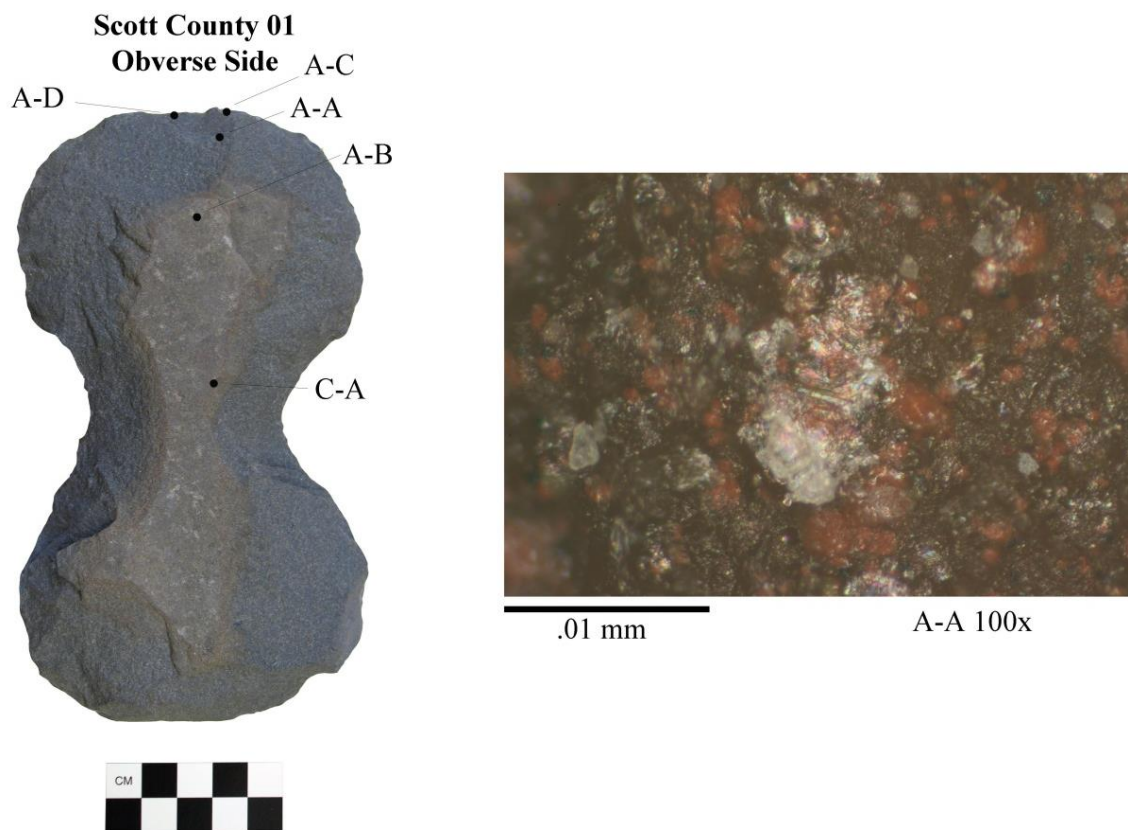


Figure 436. Experimental agricultural bit edge wear on the obverse side of Scott County 01, used as an agricultural hoe, at Location A-A, showing microplating and light abrasion.

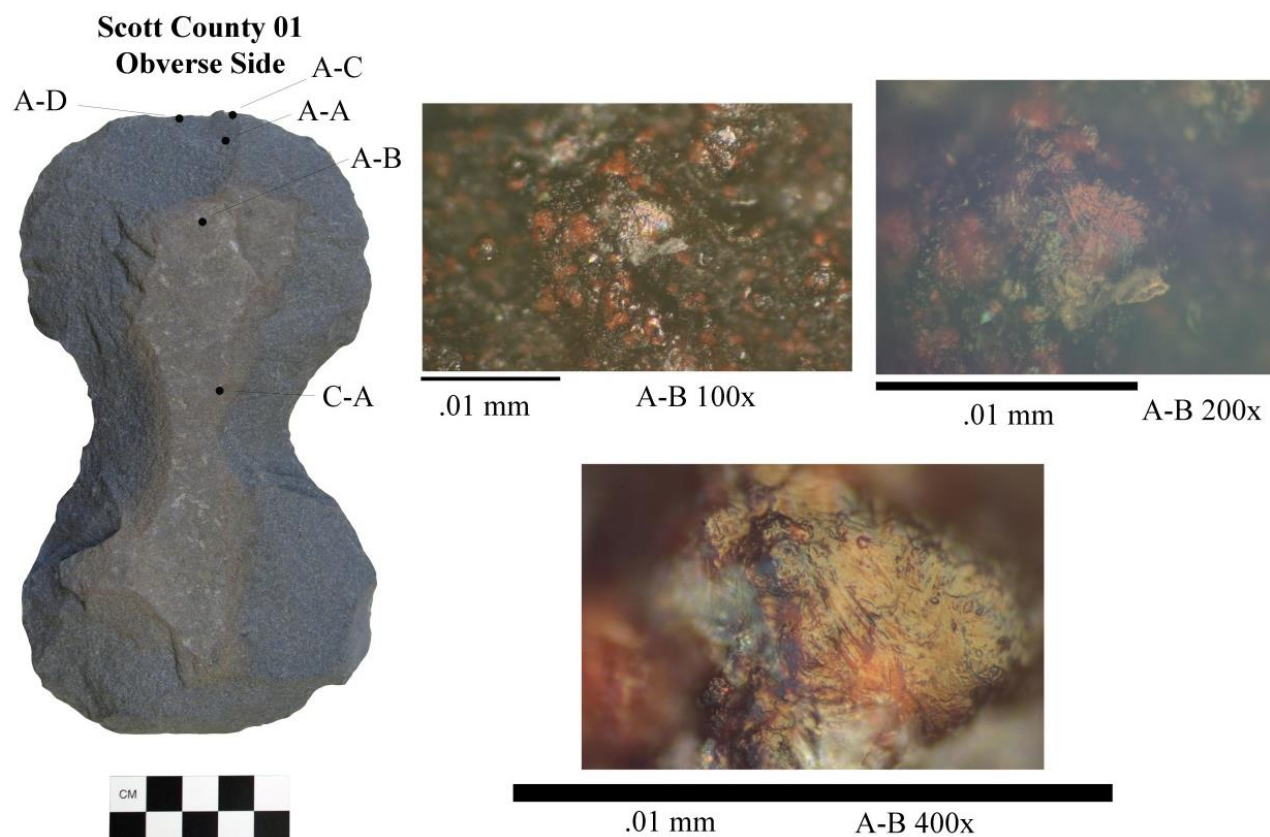
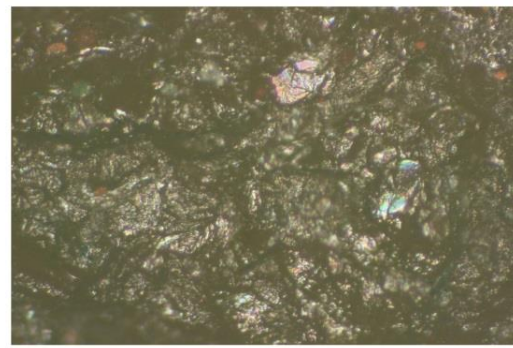
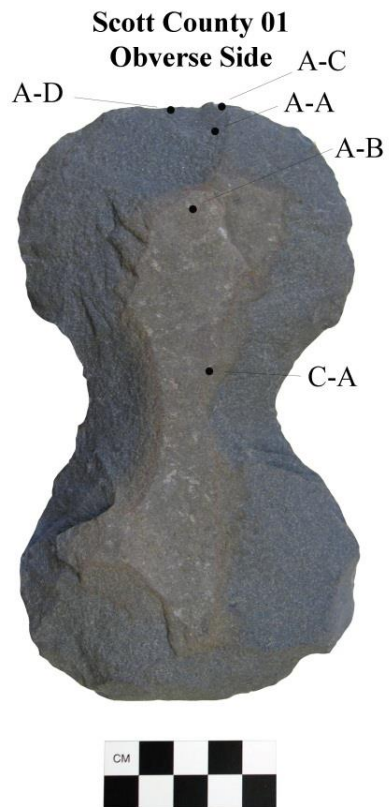
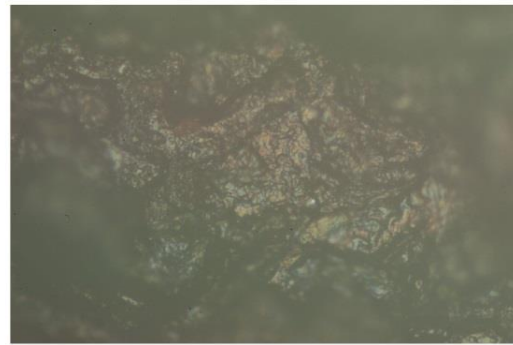


Figure 437. Experimental agricultural bit edge wear on the obverse side of Scott County 01, used as an agricultural hoe, at Location A-B, showing microplating and light abrasion.



.01 mm

A-C 100x



.01 mm

A-C 200x

Figure 438. Experimental agricultural bit edge wear on the obverse side of Scott County 01, used as an agricultural hoe, at Location A-C, showing light abrasion.

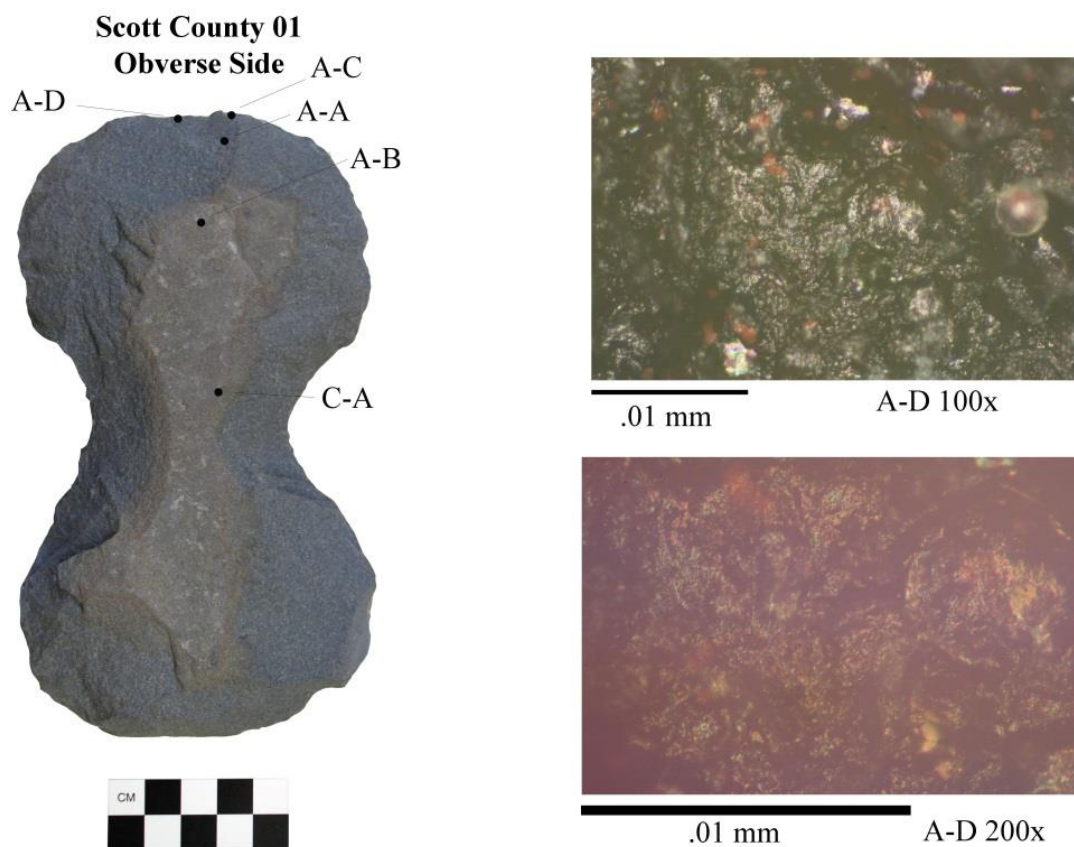


Figure 439. Experimental agricultural bit edge wear on the obverse side of Scott County 01, used as an agricultural hoe, at Location A-C, showing light abrasion and the beginnings of microplating.

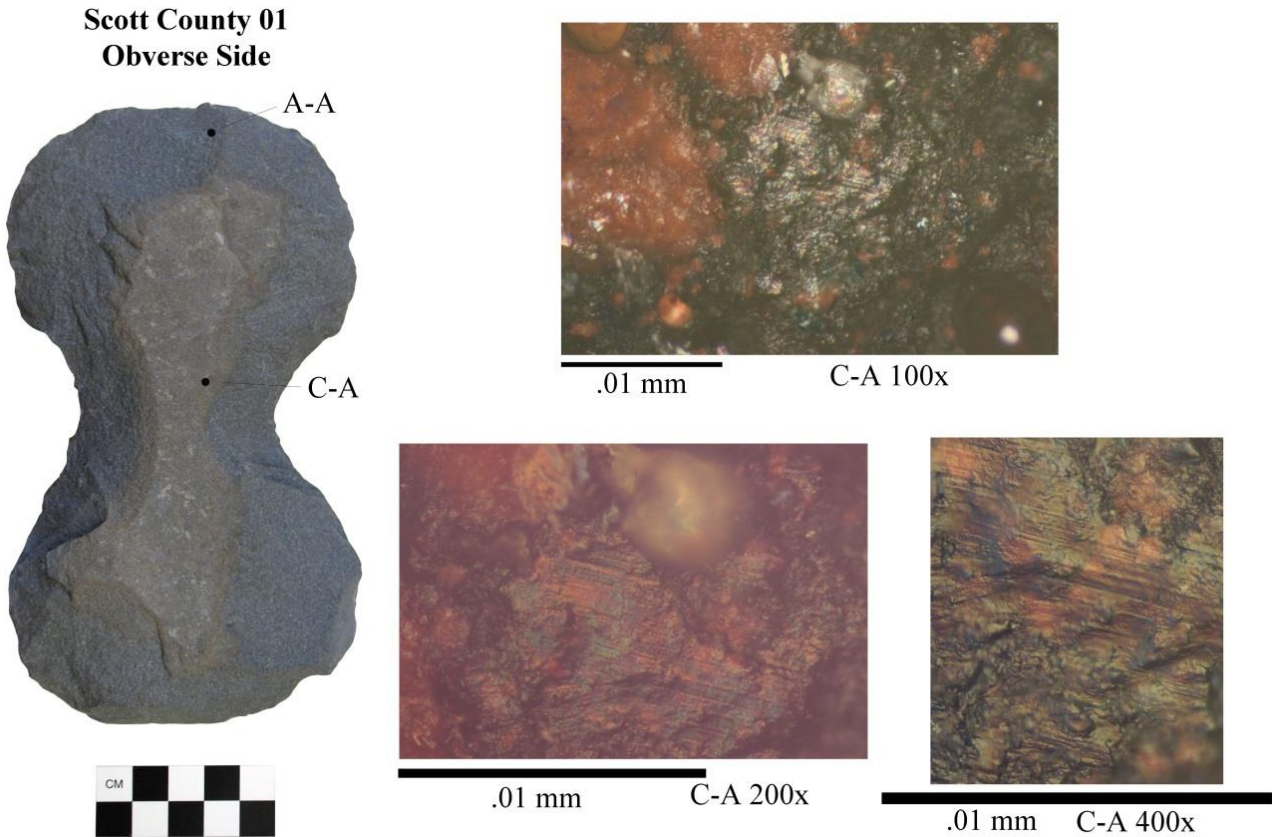


Figure 450. Experimental agricultural hafting wear on the obverse side of Scott County 01, used as an agricultural hoe, at Location C-A, both abrasive and additive wear running perpendicular to the tool's longitudinal axis.

Scott County Experimental 02

Scott County 02 is a smaller elongated replica form made of silicified sandstone which has a mass of 90 grams, with a length of 100.7 mm, a maximum width of 42.9 mm, a hafting width of 22.9 mm and a maximum thickness of 21.5 mm (Figure 451). This tool has a form similar to that of an adze and was hafted for use as an agricultural hoe. The tool was wedged into the handle and no hafting material was needed since impact during use would cause the tool to become firmly placed within the handle (Figure 452).

Scott County 02 worked extremely well removing the top portion of vegetation from the ground surface on March 27, 2013 and quickly cut through dense grasses and roots. However,

the tool fell out of the handle numerous times during the upswing of use. Multiple re-placements of the tool saw the continual error during employment. The researcher added sinew around the tool and handle in an attempt to strengthen the connection between the two. After a few modifications, the tool was able to be used consistently without failure. This tool excelled at both upper surface vegetation removal and at creating small trenches in the ground which would be beneficial for agricultural practices.

Scott County 02 was used again on April 15, 2013 and again functioned superbly as an agricultural hoe (Figure 453). It again effectively cut through surface vegetation and tilled the soil efficiently. After use, areas of potential wear could be seen on the tool edge where the methalviolet had been worn off.

Use-wear

Bit edge wear consists of heavy microplating wear with numerous striations running obliquely perpendicular to the tool's edge. Hafting wear consists of generalized abrasion with a location of heavy scraping, which is potentially wear which occurred when the tool was placed in the handle (Figures 454- 459).



Figure 451. The obverse and reverse sides of experimental Scott County 02.



Figure 452. Experimental tool hafting on Scott County 02, designed for use as an agricultural hoe with punch hafting.



Figure 453. Scott County 02 after experimental use.

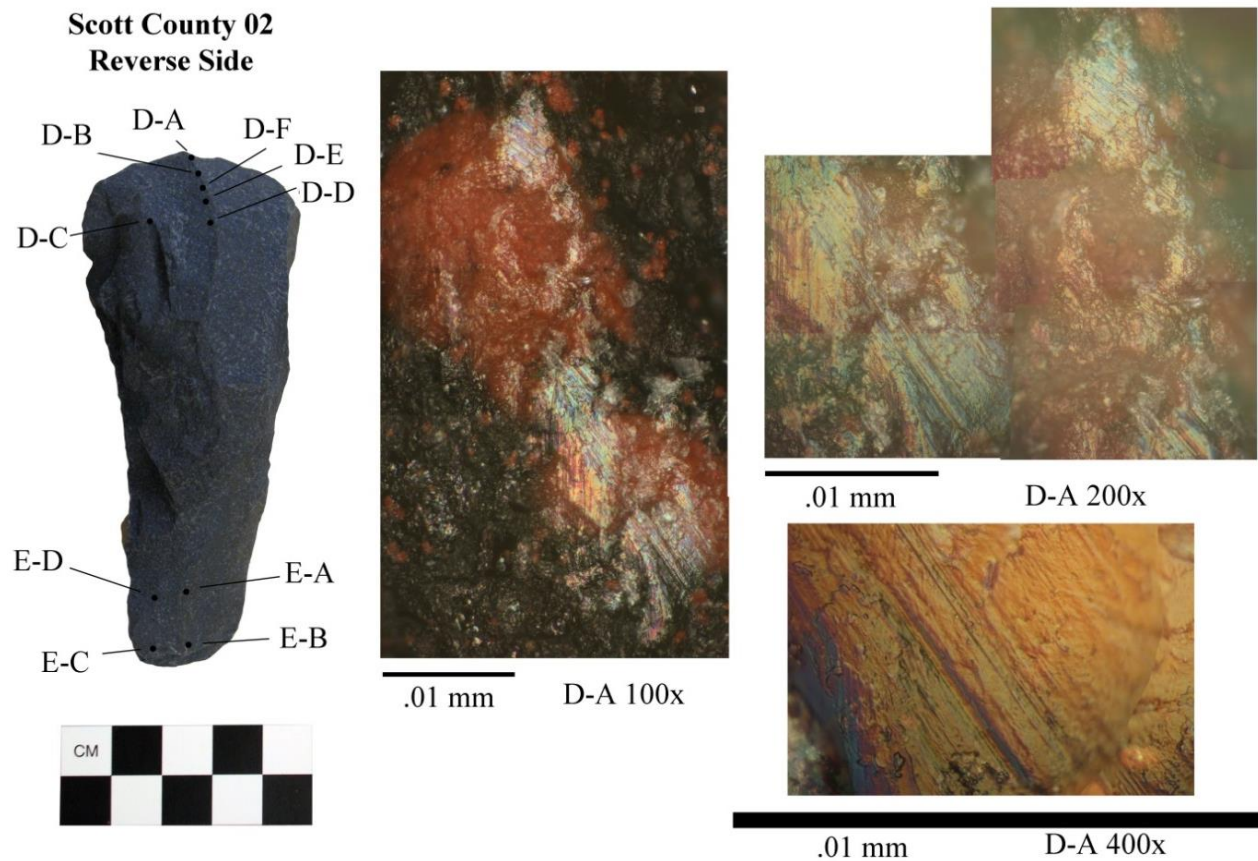


Figure 454. Experimental agricultural bit edge wear on the reverse side of Scott County 02, Location D-A showing both additive and abrasive wear. Evidence of microplating and obliquely angled striations.

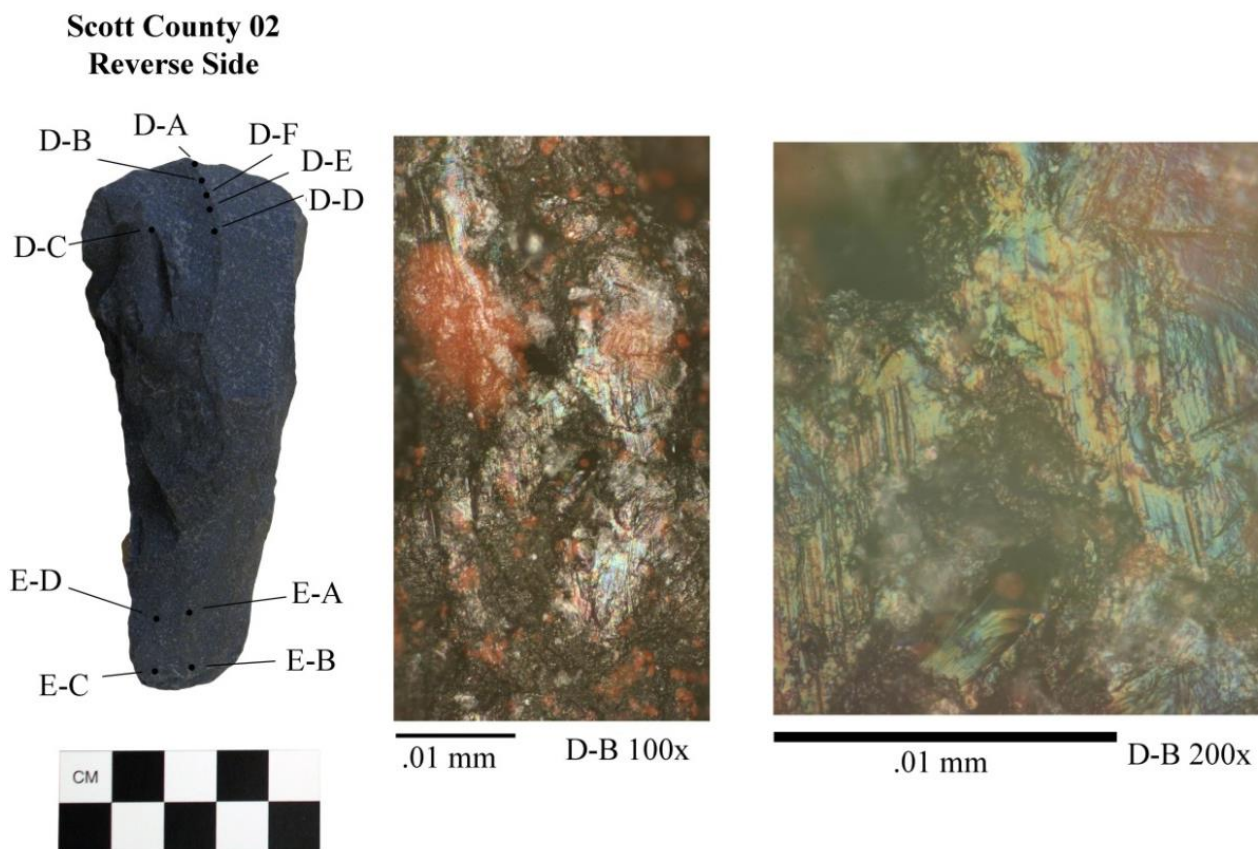


Figure 455. Experimental agricultural bit edge wear on Scott County 02, Location D-B, showing microplating and striations running perpendicular to tool edge.

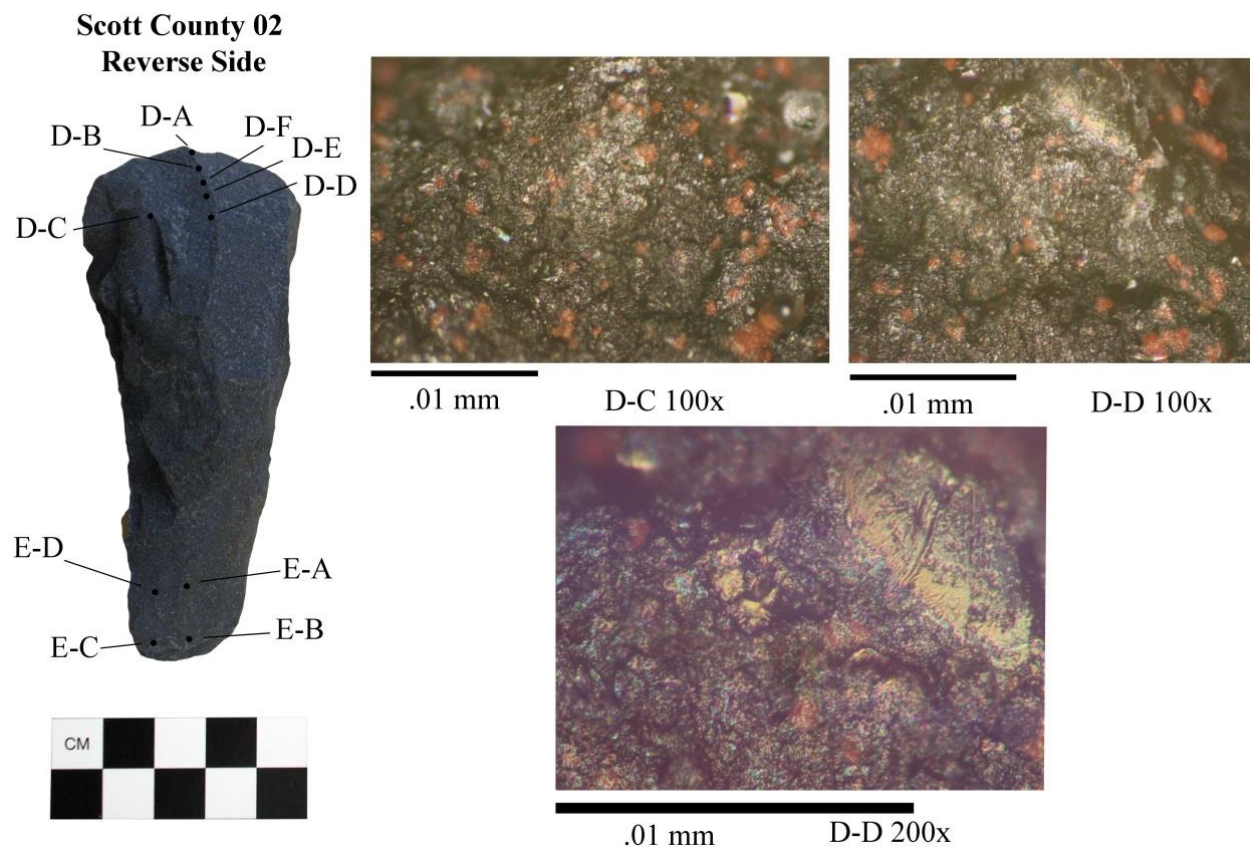


Figure 456. Experimental agricultural bit edge wear on Scott County 02, Locations D-C and D-D, showing abrasion and striations.

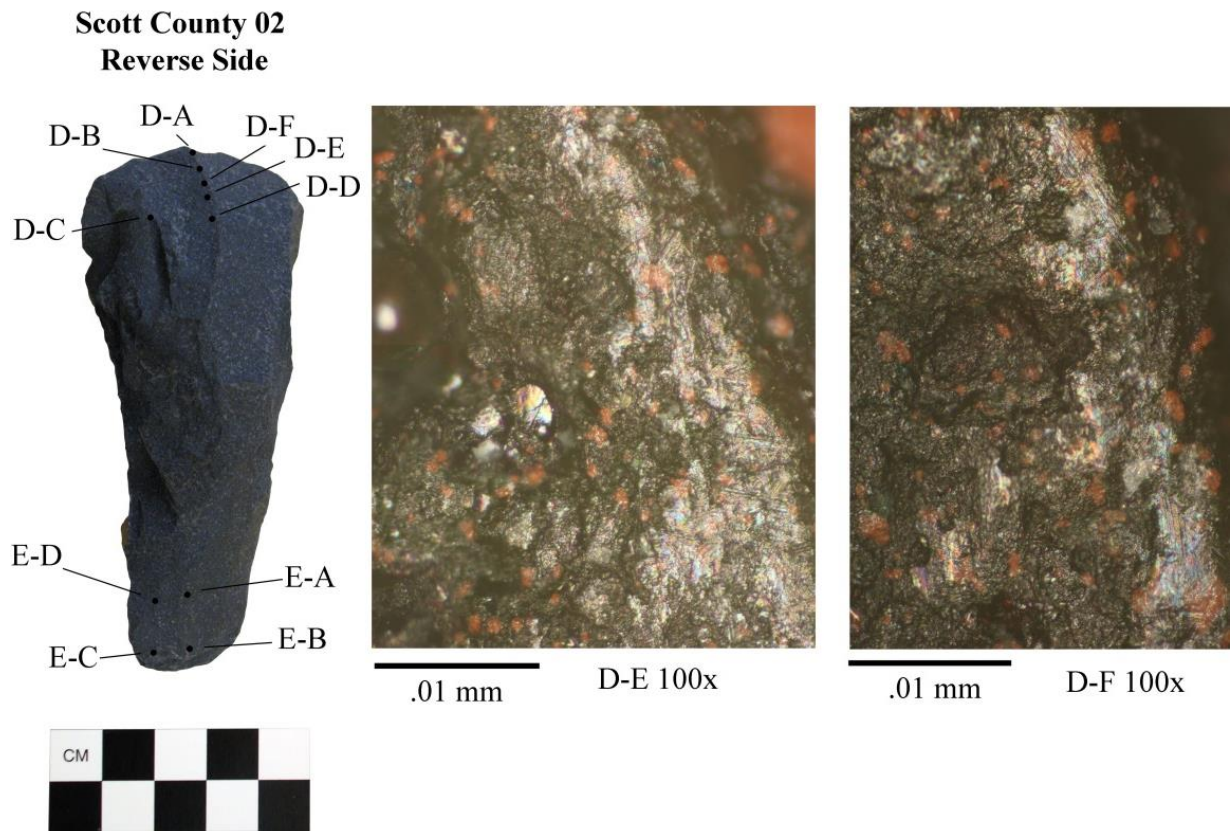


Figure 457. Experimental agricultural bit edge wear on Scott County 02, Locations D-E and D-F, showing microplating and striations.

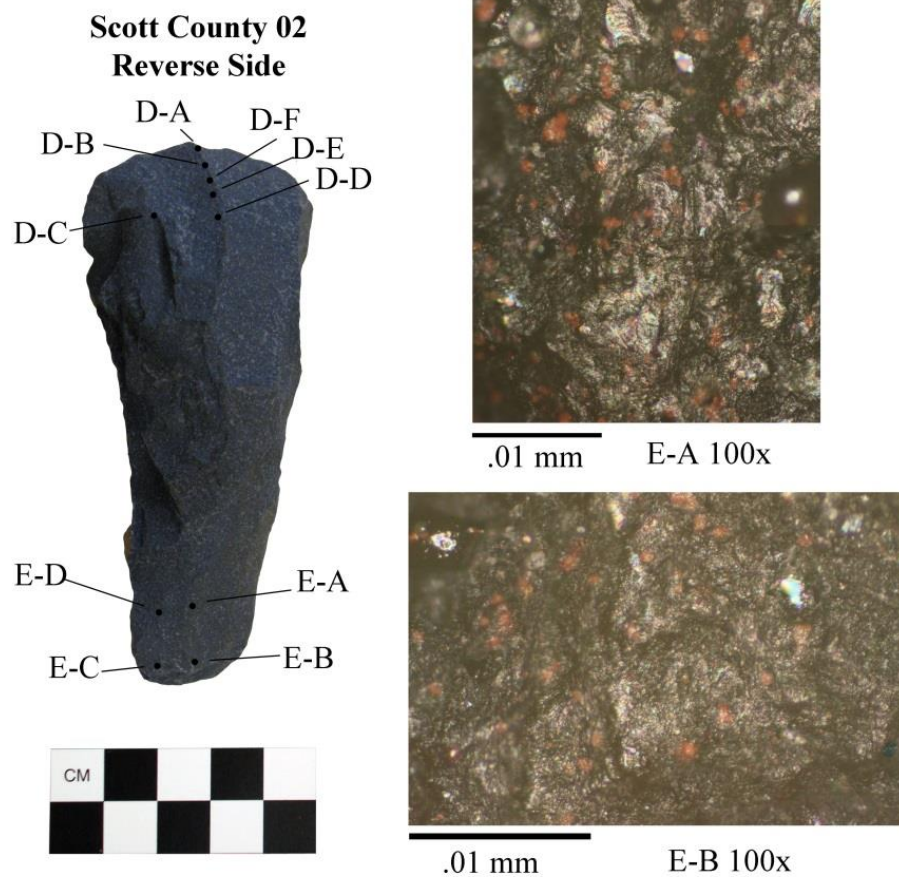


Figure 458. Experimental agricultural hafting wear on Scott County 02, Locations E-A and E-B, showing generalized abrasion and light additive wear.

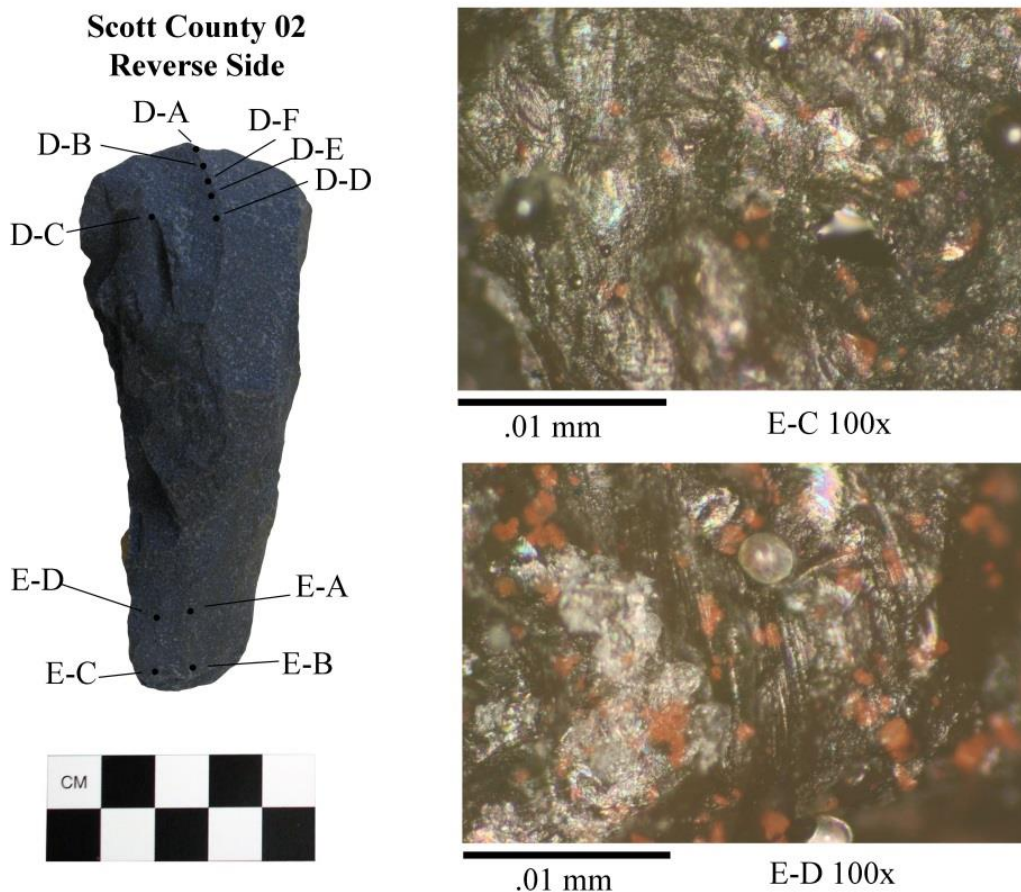


Figure 459. Experimental agricultural hafting wear on Scott County 02, Locations E-C and E-D, showing both abrasive and additive wear.

Scott County Experimental 03

Scott County 03 is a larger single bit replica form made of silicified sandstone which measures in at 173.7 grams in weight, with a length of 100.83 mm, a width of 81.42 mm, a tip width of 31.53 mm and a maximum thickness of 23.5 mm (Figure 460). This tool was hafted in an axe design using a punch form handle where the impact of the tool increases the wedge of the tool within the handle. No hafting material was used on this tool and the handle was made of cedar (Figure 461).

Scott County 01 was first used on March 26th 2013 on a small tree. To start, the tool performed exactly as planned, quickly removing the bark and moving into the hardwood, however, after a period of use, the axe head fell out of the handle. The researcher replaced the tool and continued work, however, as work progressed the tool continued to fall out of the handle. The researcher tried replacing the tool into the handle in different ways to attempt to increase productivity. The tool eventually felled a tree about 4 inches in diameter and was still a useable tool. If Scott County 03 would have remained within the handle, it would have had even greater productivity (Figure 462 and 463).

Scott County 03 was used again on March 27, 2013 and again performed excellently as an axe by easily cutting through bark and both soft and hard wood. The tool's curved handle seemed to increase its effectiveness. The length of the handle also allowed the researcher to use one or two hands to swing the tool, helping to increase efficiency.

Scott County 03 was also used on April 15, 2013 and continued to be one of the most productive tools in the collection. On this day, the tool was used by a left handed researcher and still performed excellently. Scott County 03 felled another tree with relative ease and with continued use, the stone portion of the tool began to stay in the handle for longer periods of time. On this day, the handle of Scott County 03 began to split from the top down the center of the tool. Prior to complete tool failure, the top of the handle was wrapped tightly with cordage. Through this action, tool use was prolonged and was able to still function; however, handle failure eventually caused the tool to no longer be usable.

Use-wear

Bit edge and hafting wear consist of generalized abrasion with the beginnings of microplating wear (Figures 464- 466).



Figure 460. The obverse and reverse sides of Scott County 03.



Figure 461. Experimental hafting for Scott County 03, designed for use as an woodworking axe with punch hafting.



Figure 462. Scott County 03 experimental use.



Figure 463. Scott County 03 experimental use.

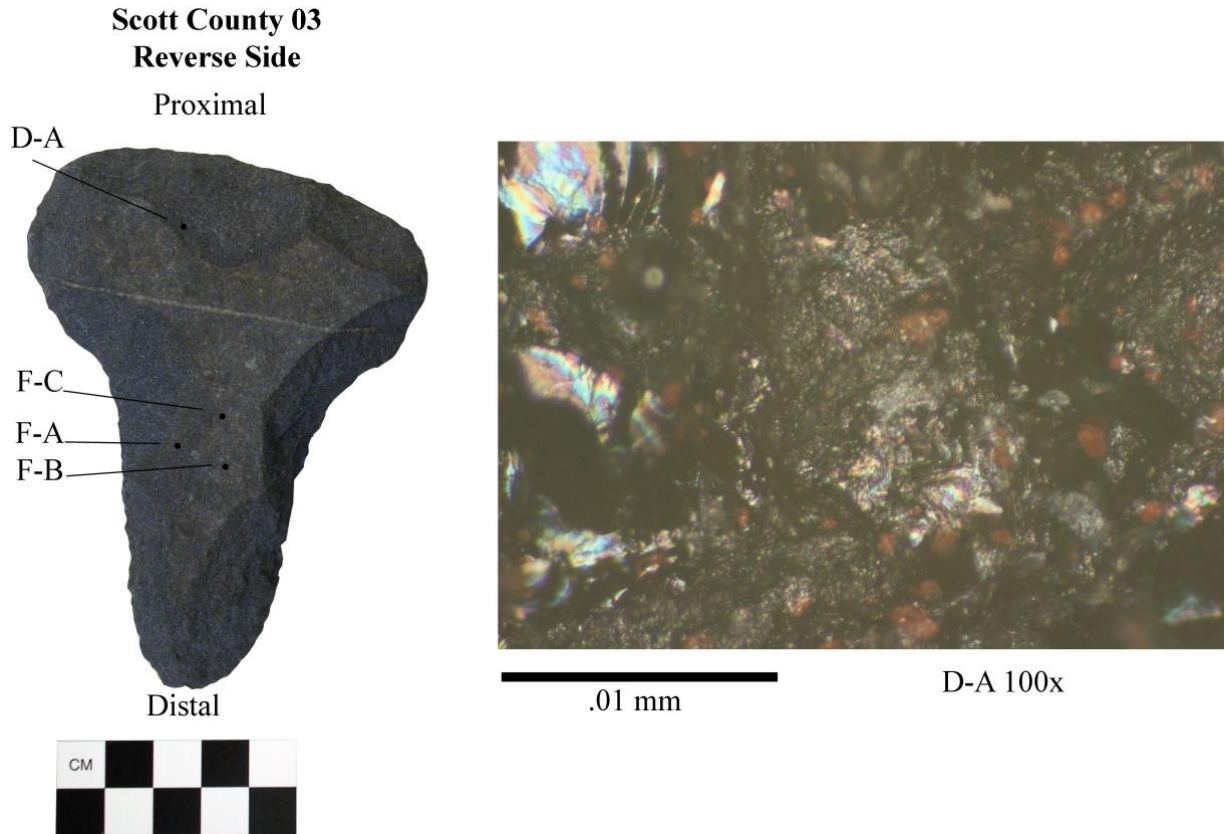
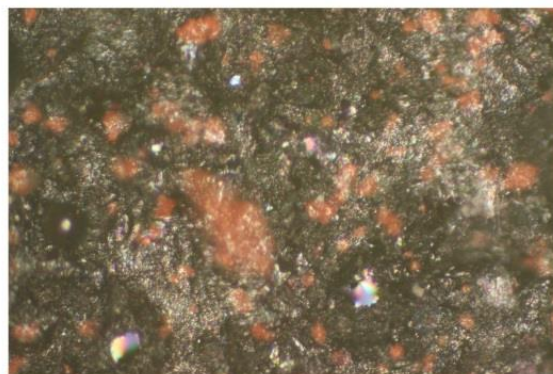
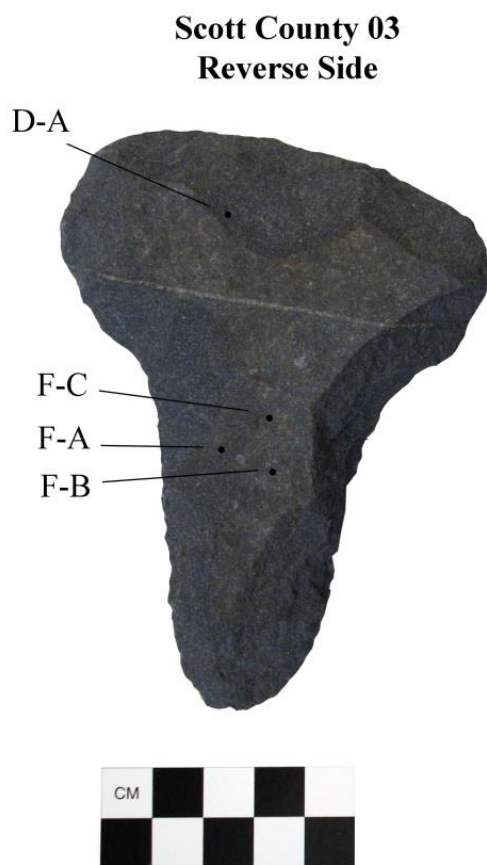
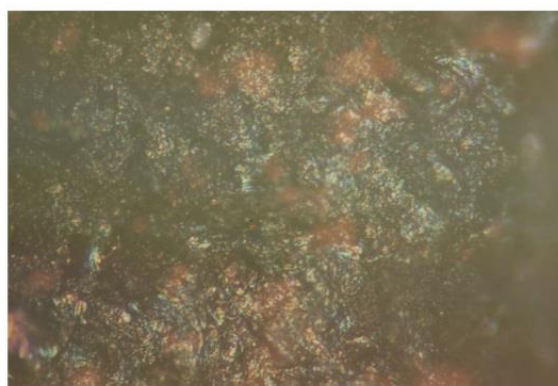


Figure 464. Experimental woodworking bit wear on Scott County 03, Location D-A, showing light abrasion and the beginnings of microplating.



.01 mm

F-A 100x



.01 mm

F-A 200x

Figure 465. Experimental woodworking hafting wear on Scott County 03, Location F-A, showing generalized abrasion.

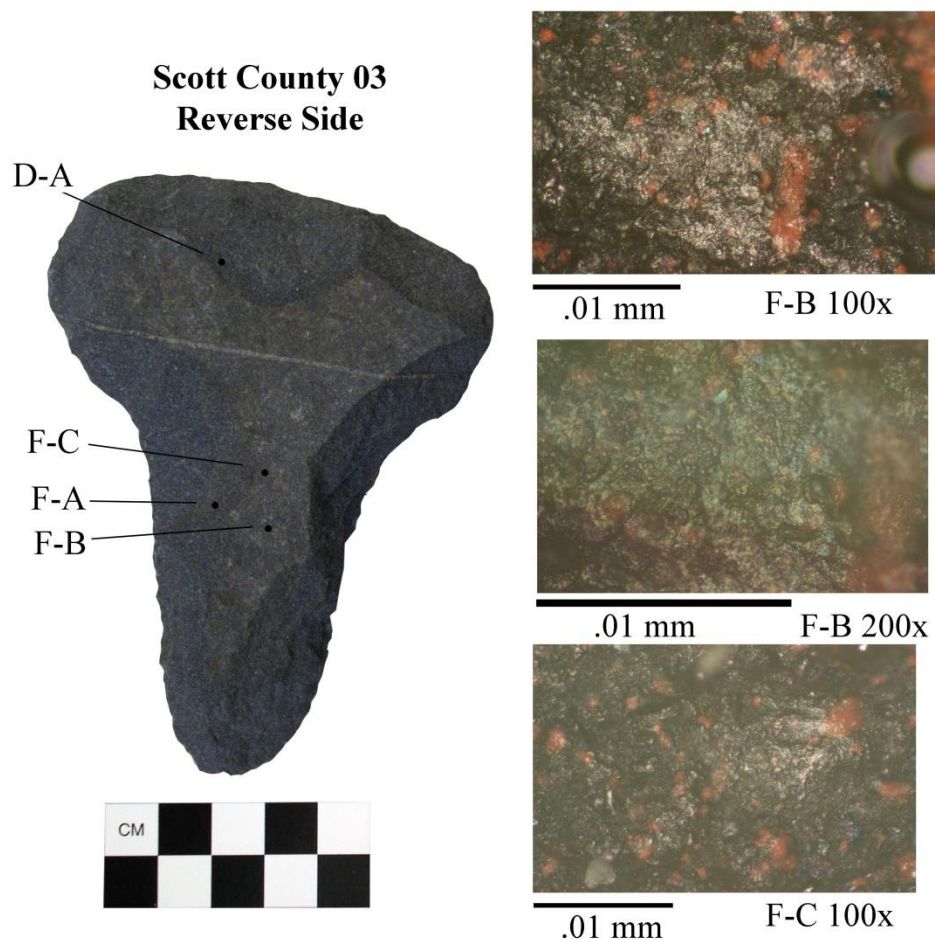


Figure 466. Experimental woodworking hafting wear on Scott County 03, Locations F-B and F-C, showing generalized abrasion.

Scott County Experimental 04

Scott County 04 is the smallest replica in the experimental collection and is single bitted in form made of silicified sandstone (Figure 467). The tool weighed in at 29.4 grams, with a length of 56.2 mm by 49.92 mm in width, a tip width of 11.63 mm and a maximum thickness of 13.4 mm. The tool was hafted as an axe in the punch formed hafting where it was wedged into a hole previously drilled into the handle (Figure 468).

Scott County 04 was first used on March 27, 2013 and immediate problems occurred due to the tool falling out of the handle (Figure 469). The researcher added sinew to the tool to

attempt to keep the tool within the handle. This addition helped to stabilize the tool and it was able to remove the outer bark from multiple trees, however, it was not very effective against the hard wood of the trees, potentially due to its size and lack of weight.

Scott County 04 was used again on April 15, 2013 when it experienced catastrophic tool failure. During impact, the tool snapped where it met the wood of the handle, separating the larger bit edge from the tip.

Use-wear

Bit edge wear consists of generalized abrasion with a few small locations of microplating. Hafting wear shows light generalized wear (Figures 470-471).



Figure 467. The obverse and reverse sides of experimental Scott County 04.



Figure 468. Experimental hafting for Scott County 04, designed for use as a woodworking axe with punch form hafting.



Figure 469. Scott County 04 during experimental use. Photo taken by Nicole Schuler on March 27, 2013 in Fayetteville Arkansas.

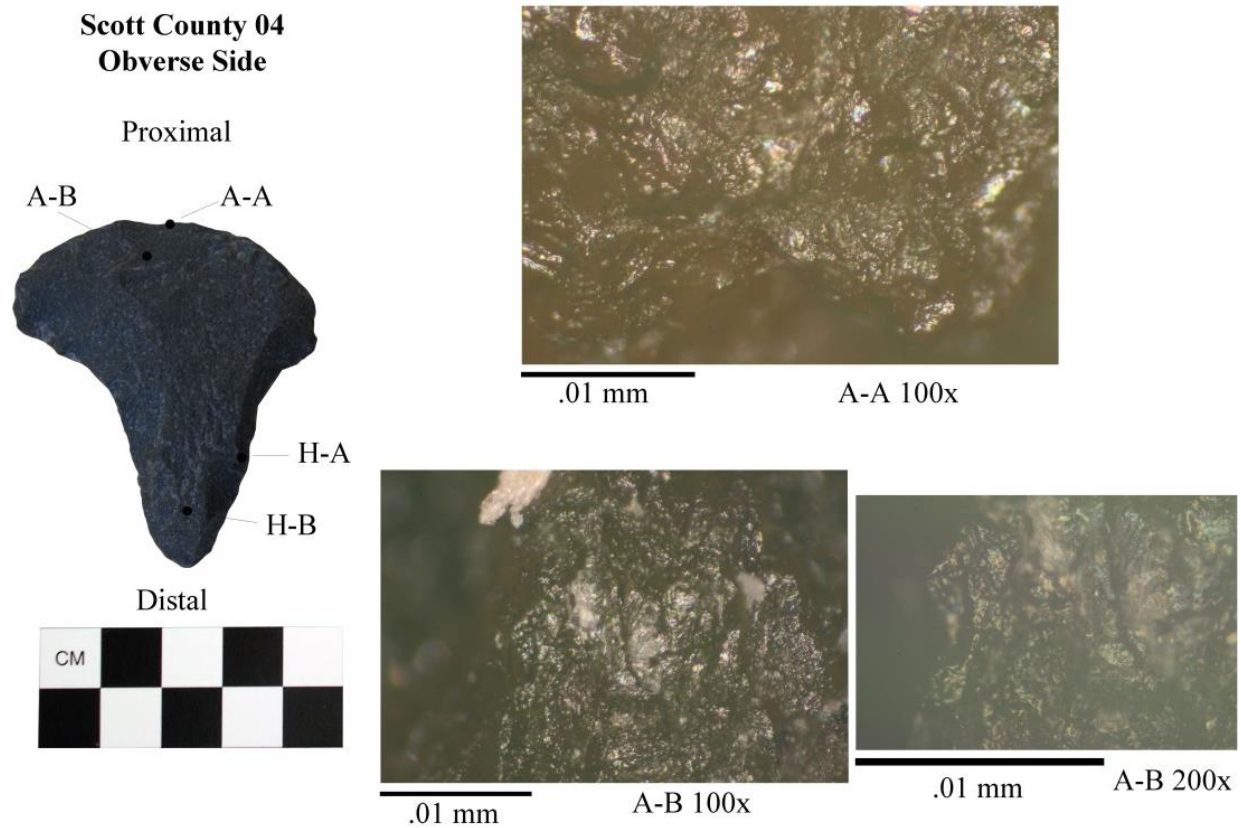


Figure 470. Experimental woodworking bit edge wear on Scott County 04, Locations A-A and A-B, showing light abrasion and the beginnings of microplating.

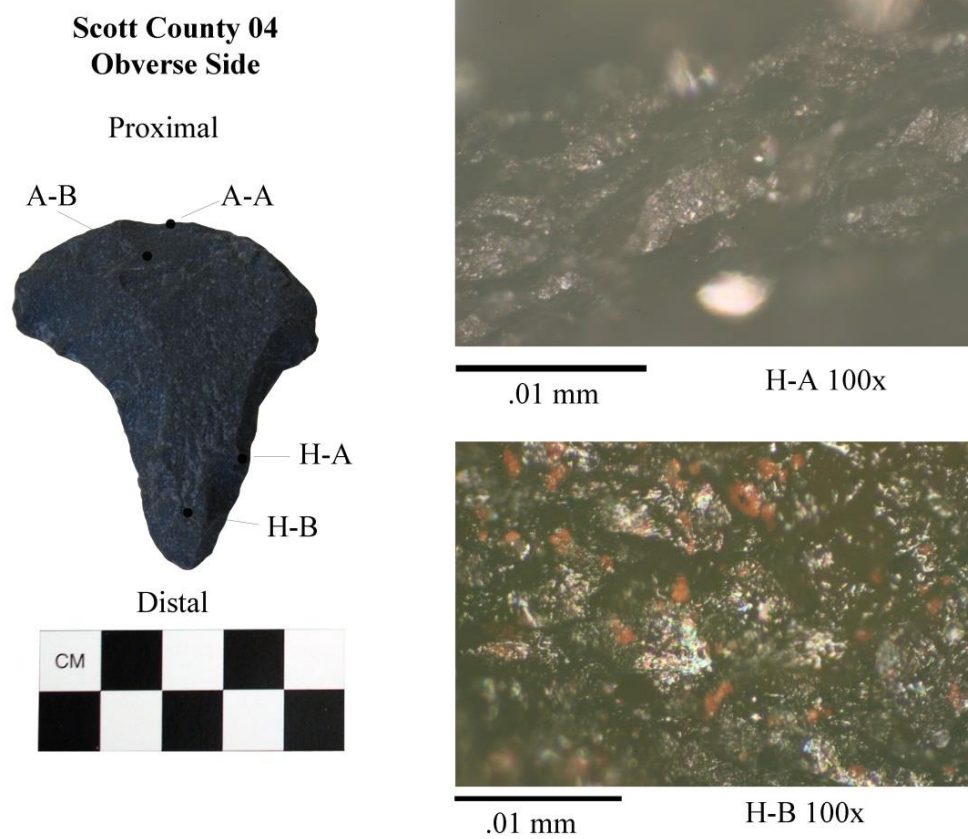


Figure 471. Experimental woodworking hafting wear on Scott County 04, Locations H-A and H-B, showing generalized abrasion.

Scott County Experimental 05

Scott County 05 is a smaller single bitted replica form made of silicified sandstone (Figure 472). The tool weighs 40.7 grams and measures 63.56 mm in length, 50.91 mm in width, 13.94 mm in tip edge width, and has a maximum thickness of 16.0 mm.

Scott County 05 was damaged during production as it was first being hafted. The tool was going to be placed in a handle in an axe form punch hafting and as the tool was hammered into the handle it snapped at the weakest point, near the tip of the tool where it met the wood of the handle (Figure 473).



Figure 472. The obverse and reverse sides of Scott County 05.



Figure 473. The catastrophic damage which occurred to Scott County 05 during experimental production.

Scott County Experimental 06

Scott County 06 is a medium sized replica made of novaculite chert in the double bitted form (Figure 474). The tool weighs 145.3 grams and is 98.76 mm in length by 68.75 mm in width, with a hafting width of 48.53 mm and maximum thickness of 18.2 mm. This tool was set up for use as an agricultural hoe and was hafted on a hickory branch with the supportive portion located underneath the tool. The hafting consisted of dried willow bark (Figure 475).

Scott County 06 was first used on March 27th 2013 on a ground surface with naturally occurring grass vegetation. Soil was a sandy loam with common small rocks and medium to

small sticks and roots. Scott County 06 worked extremely well at breaking up the soil and cutting through any roots and vegetation which were preset. Through use of the tool, the willow bark eventually failed due to the movement of the tool on the handle, causing the tool to cut through the binding. However, a large patch of soil was easily excavated using this tool.

Scott County 06 was removed from its original handle and re-hafted using sinew. With the addition of the stronger sinew as a hafting agent for the tool, Scott County 06 continued to work exceptionally well as a hoe. Scott County 06 was again used on April 15, 2013. The tool continued performed well as an agricultural hoe with no errors.



Figure 474. The obverse and reverse sides of experiemtnal Scott County 06.



Figure 475. Experimental hafting on Scott County 06, designed for use as an agricultural hoe with both willow bark and synthetic sinew as hafting material.

Scott County Experimental 07

Scott County 07 created in the double bitted form is one of the larger replicas in the experimental collection weighing in at 258.8 grams (Figure 476). Made of silicified sandstone, the length of the tool is 122.15 mm and width is 74.32 mm with a hafting width of 55.97 mm and a maximum thickness of 22.7 mm.

The tool was hafted as an agricultural hoe with the supportive portion of the handle located underneath the tool. Scott County 07 was hafted on the handle with a small amount of organic sinew. The supportive portion of the handle was placed underneath of the tool and a wedge was used to help hold the tool in place and to tighten the hafting material (Figure 477).

Scott County 07 was first used on March 27th 2013 on a ground surface with naturally occurring grasses, vegetation and a mixture of rocky and silt soils. This tool had some difficulties cutting through the upper vegetation especially if it was densely packed or had a thick root system; however, it easily cut through and tilled soil. Scott County 07 was used again on April 15th and continued to be an adequate tool for agricultural purposes.

Use-wear

Bit edge wear consists of heavy microplating wear with directional striations running perpendicular to the bit edge with some of the striations partially filled in. Hafting wear consists of generalized abrasion with few small locations of microplating (Figure 478 -482).



Figure 476. The obverse and reverse sides of experimental Scott County 07.



Figure 477. Experimental hafting on Scott County 07, designed for use as an agricultural hoe with organic sinew for the hafting material.

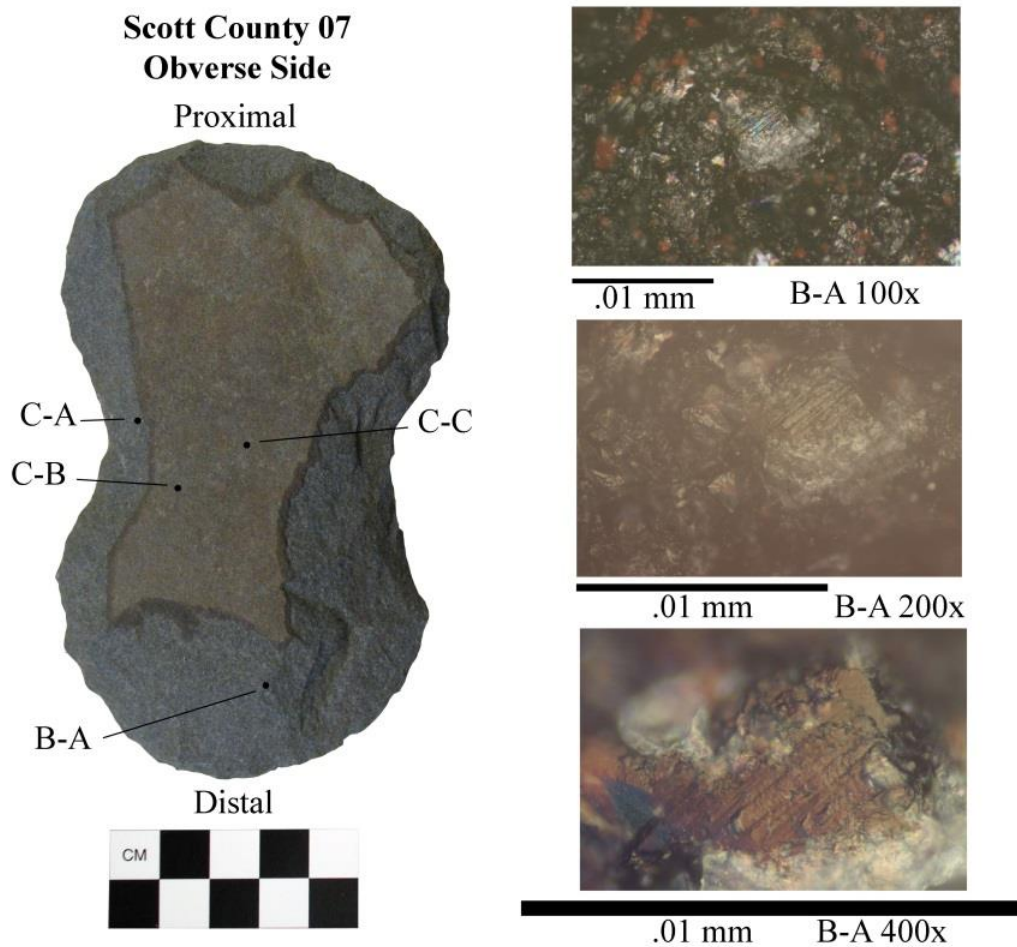


Figure 478. Experimental agricultural bit wear on Scott County 07, Location B-A, showing microplating and striations.

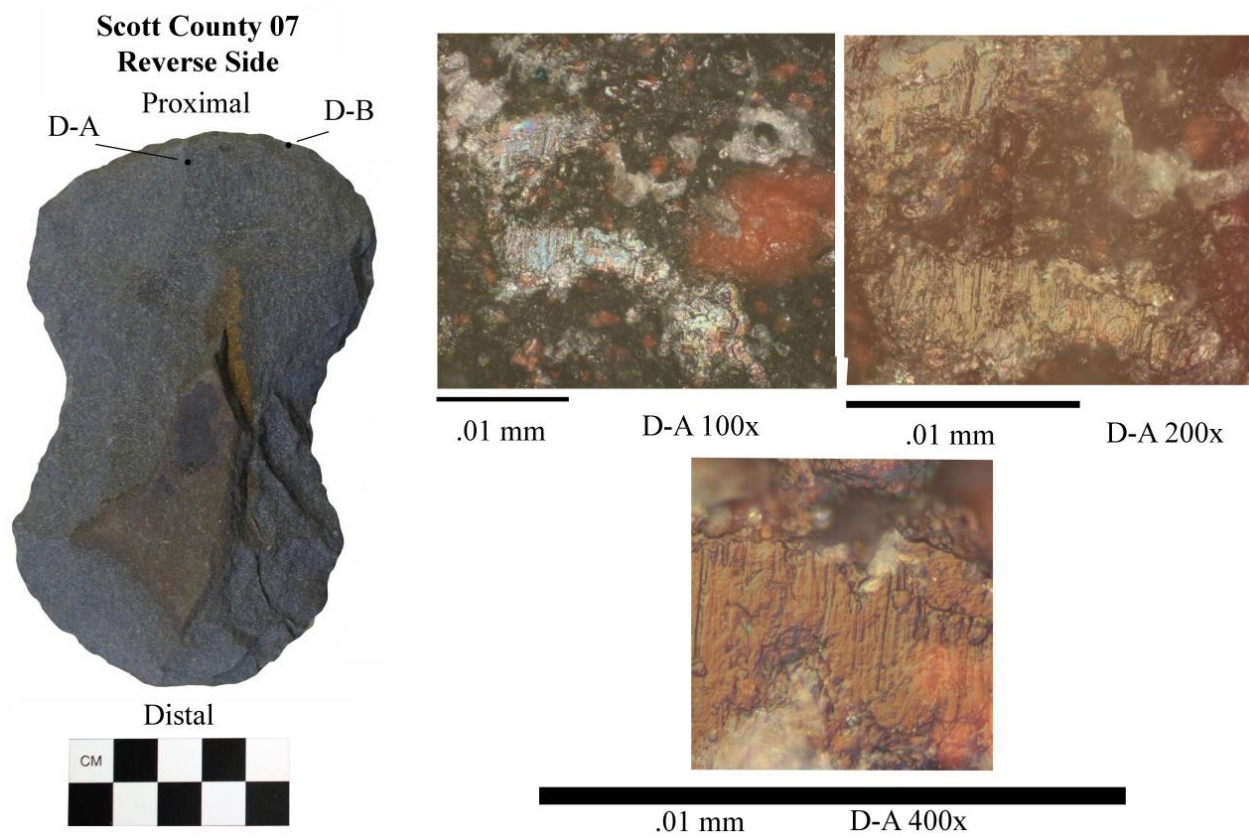


Figure 479. Experimental agricultural bit wear on the reverse side of Scott County 07, Location D-A, showing microplating and striations running perpendicular to the bit edge.

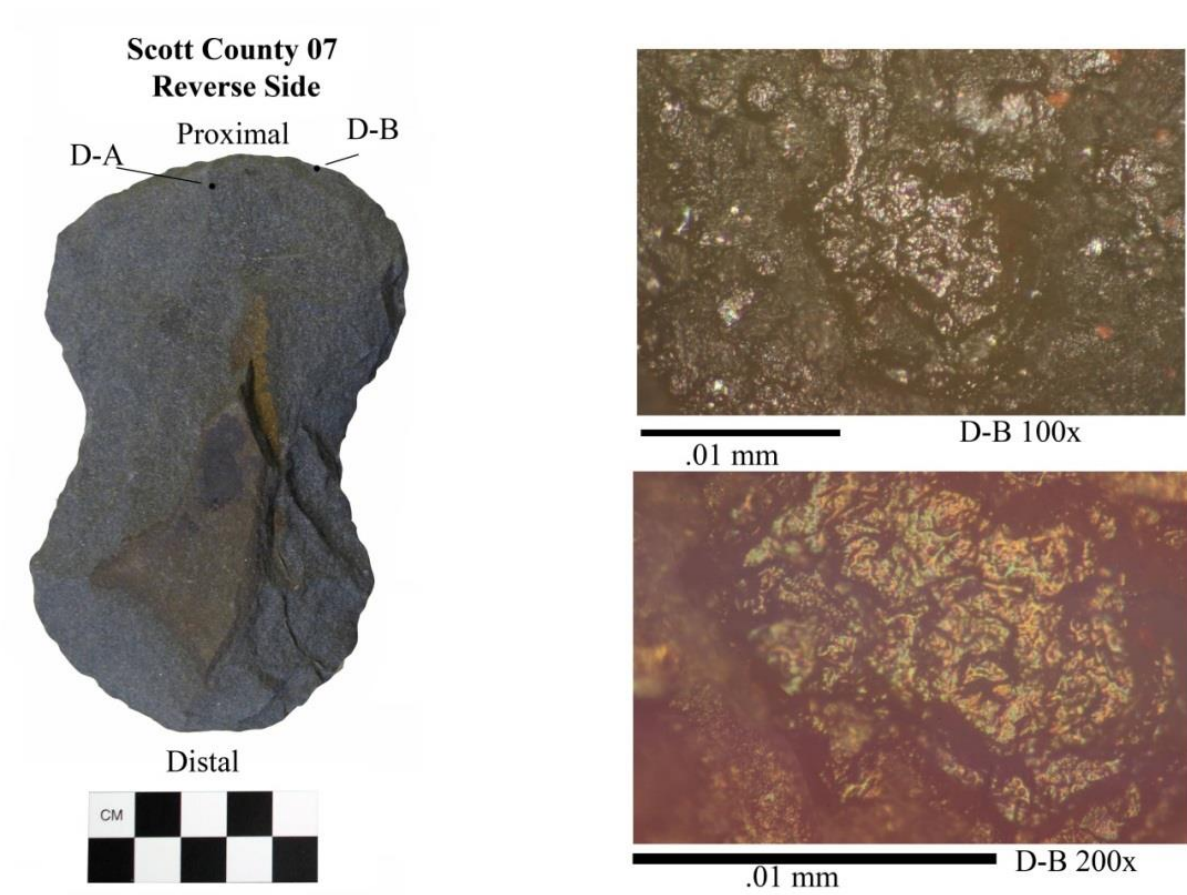
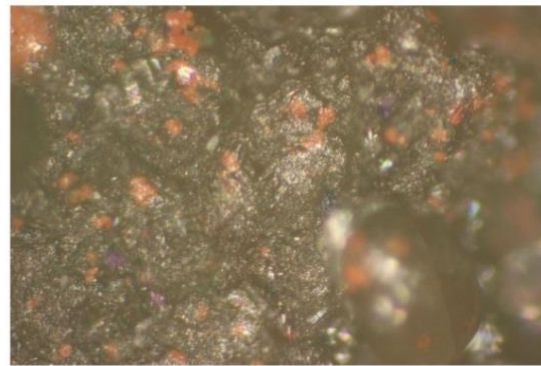
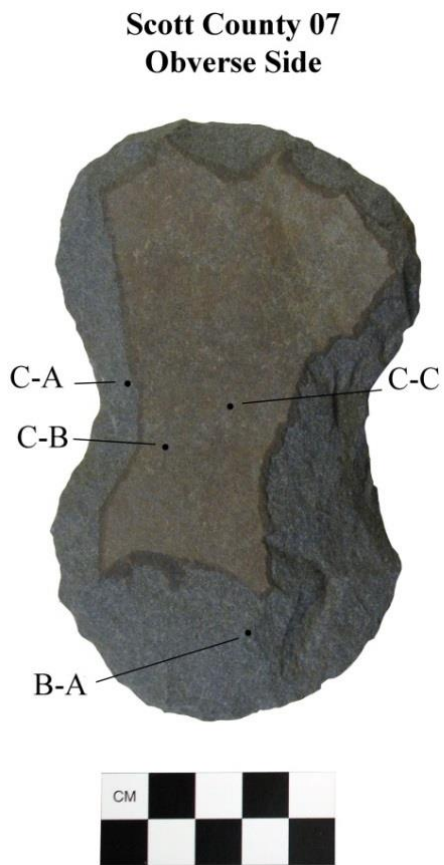
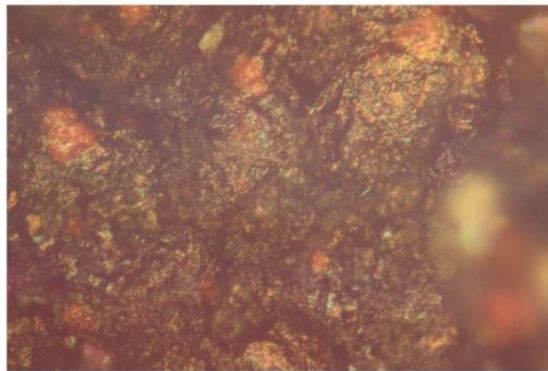


Figure 480. Experimental cast error on the reverse side of Scott County 07, Location D-B, showing error in the form of oil.



.01 mm

C-A 100x



.01 mm

C-A 200x

Figure 481. Experimental agricultural hafting wear on the obverse side of Scott County 07, Location C-A, showing light abrasion and the beginnings of microplating.

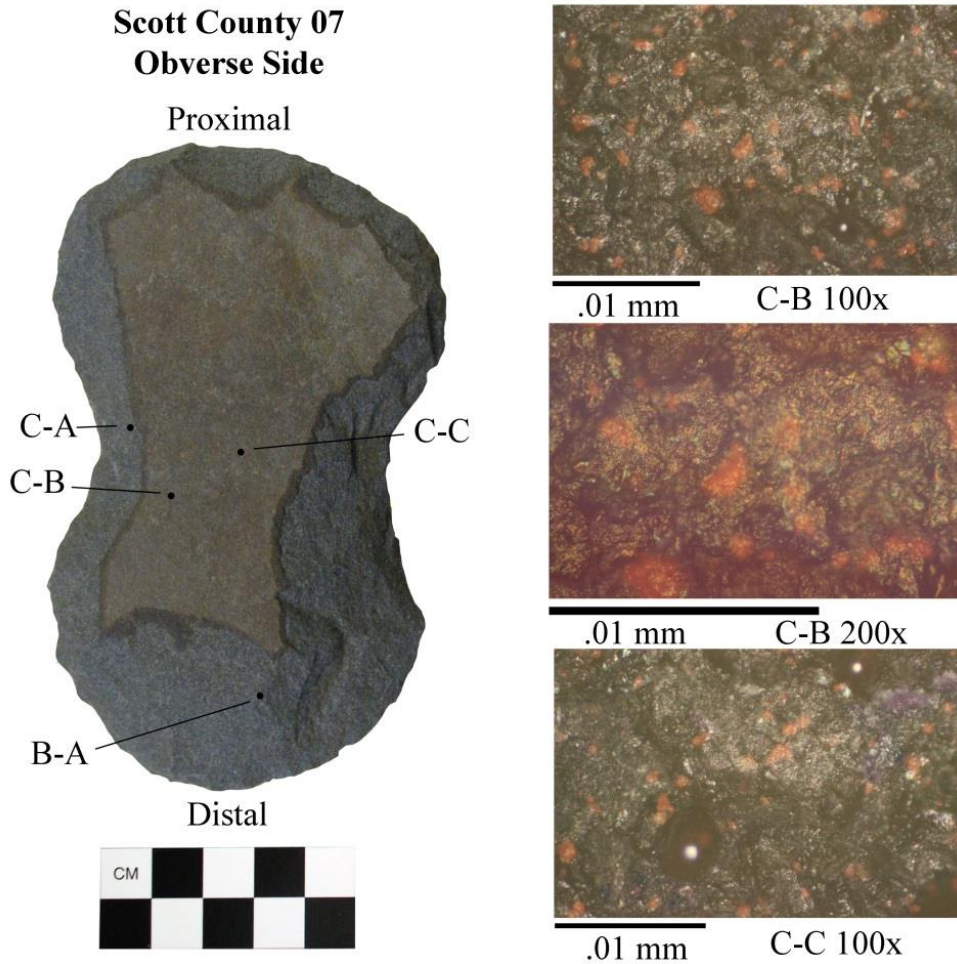


Figure 482. Experimental agricultural hafting wear on the obverse side of Scott County 07, Locations C-B and C-C showing light abrasion.

Scott County Experimental 08

Scott County 08 is a small double bitted replica form which weighs 154.9 grams (Figure 483). The measurements of this tool are 88.59 mm in length, 57.72 mm in maximum width, 41.59 mm in hafting width and a maximum thickness of 21.4 mm. This tool has a large step fracture, which occurred during production, on the obverses side's central hafting portion. This fracture was not close enough to the bit edge to affect the use of the tool.

Scott County 08 was hafted in the axe form, with the central hafting portion of the tool placed in the center of the handle. The handle had a wedge removed from the center of the wood

and the tool was wedged in. The tool was wrapped with processed willow bark to secure the placement of the tool within the handle (Figure 484).

Scott County 08 was first used on March 26, 2013 on a small tree measuring less than 4 inches in diameter (Figure 485). The tool worked well, easily removing the outer bark of the tree. As the axe began to work on the hardwood of the tree, the impact began to cause the tool to shift within the handle. As the tool moved within its setting, the willow bark began to unravel. As the hafting material began to fail the upper portion of the handle broke, rendering the tool unusable. The stone itself was still intact and was able to be re-hafted for continuous use.

Scott County 08 was re-hafted using cordage and was use again on May 25, 2013. With the better hafting material, the tool performed well at removing the outer layer of bark, but did not do as well against the hard wood.



Figure 483. The obverse and reverse sides of experimental Scott County 08.



Figure 484. Experimental hafting on Scott County 08 designed for use as a woodworking axe with central handle hafting and dried willow bark.



Figure 485. Scott County 08 experimental use.

Scott County Experimental 09

Scott County 09 is a small single bitted replica form, weighing in at 44.4 grams. The measurements of this tool are 58.63 mm in length, 52.4 mm in maximum width near the bit end, 18.88 mm in width at the tip and a maximum thickness of 17.8 mm (Figure 486).

Scott County 09 was hafted as an axe in a punch form handle where the tool was wedged into a hole previously drilled into the handle. By punching the tool into the handle, there was no need for any additional type of hafting material to secure the tool to the handle (Figure 487).

Scott County 09 was first used on March 26, 2013 on a small tree about 2 inches in diameter (Figure 488). During the process the outer bark was easily removed, however, the hardwood was significantly more difficult and was a challenge to fell the tree with tool. After a significant period of time and a lot of whacking, the tree eventually felled. At the beginning of the experimental use, the tool fell out of the handle once upon impact. After the stone was wedged back into the handle the tool remained intact and tool was continued to be function. This tool was used for a second tree felling on the same day and performed with the same quality as the first use. Scott County 09 was used again on March 27, 2013 and cut easily through the outer bark and first layer of soft wood; however against the hard wood of the tree it was rather ineffective.

Use-wear

Bit edge wear consists of generalized abrasion with one small location of microplating with light directional striations running perpendicular to the tool edge (Figure 489- 490).



Figure 486. The obverse and reverse sides of experimental Scott County 09.



Figure 487. Experimental hafting on Scott County 09, designed for use as a woodworking axe, with punch hafting.



Figure 488. Scott County 09 experimental use.

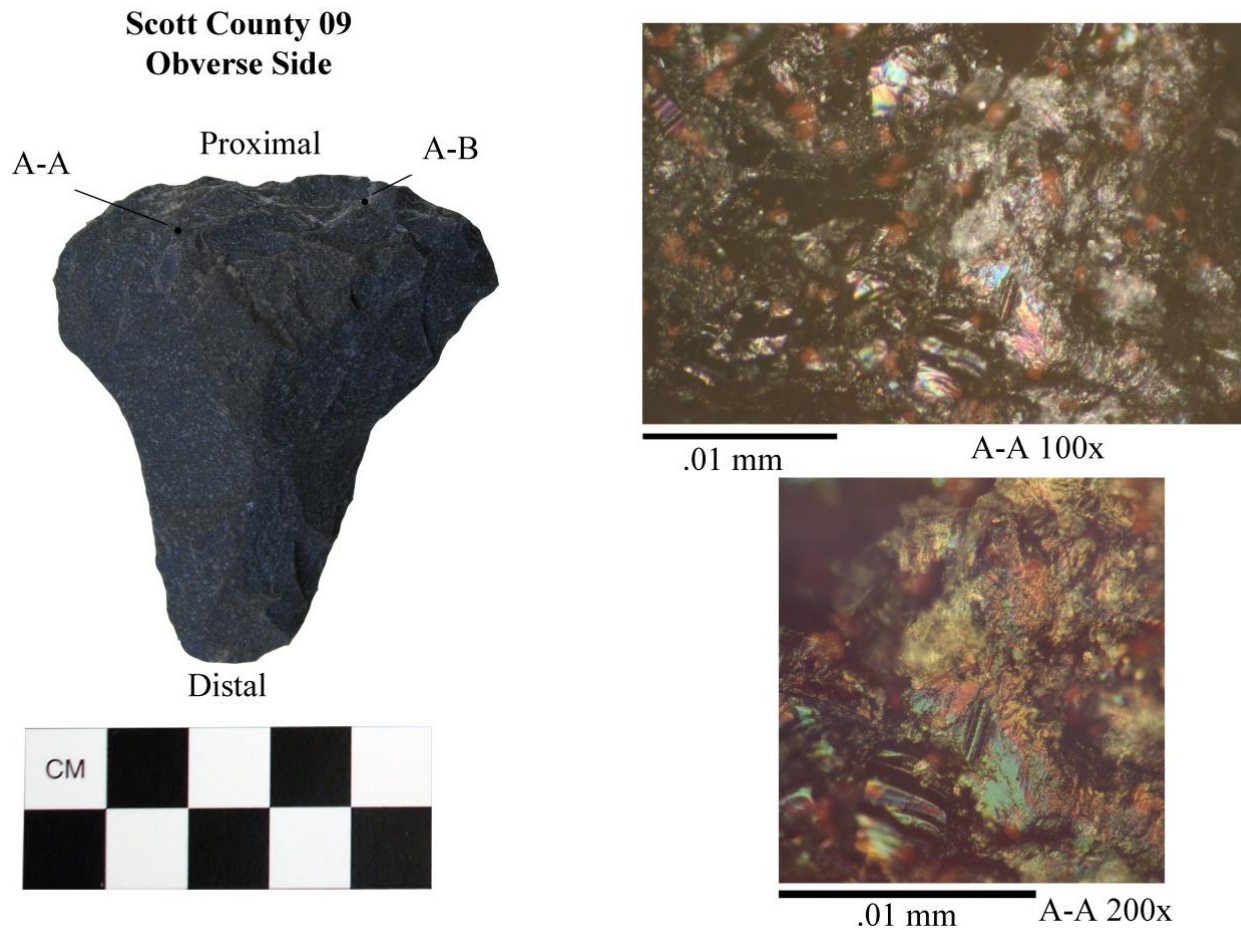


Figure 489. Experimental woodworking bit edge wear on the obverse side of Scott County 09, Location A-A, showing microplating additive wear and pseudo-wear in the form of conchoidal fractures.

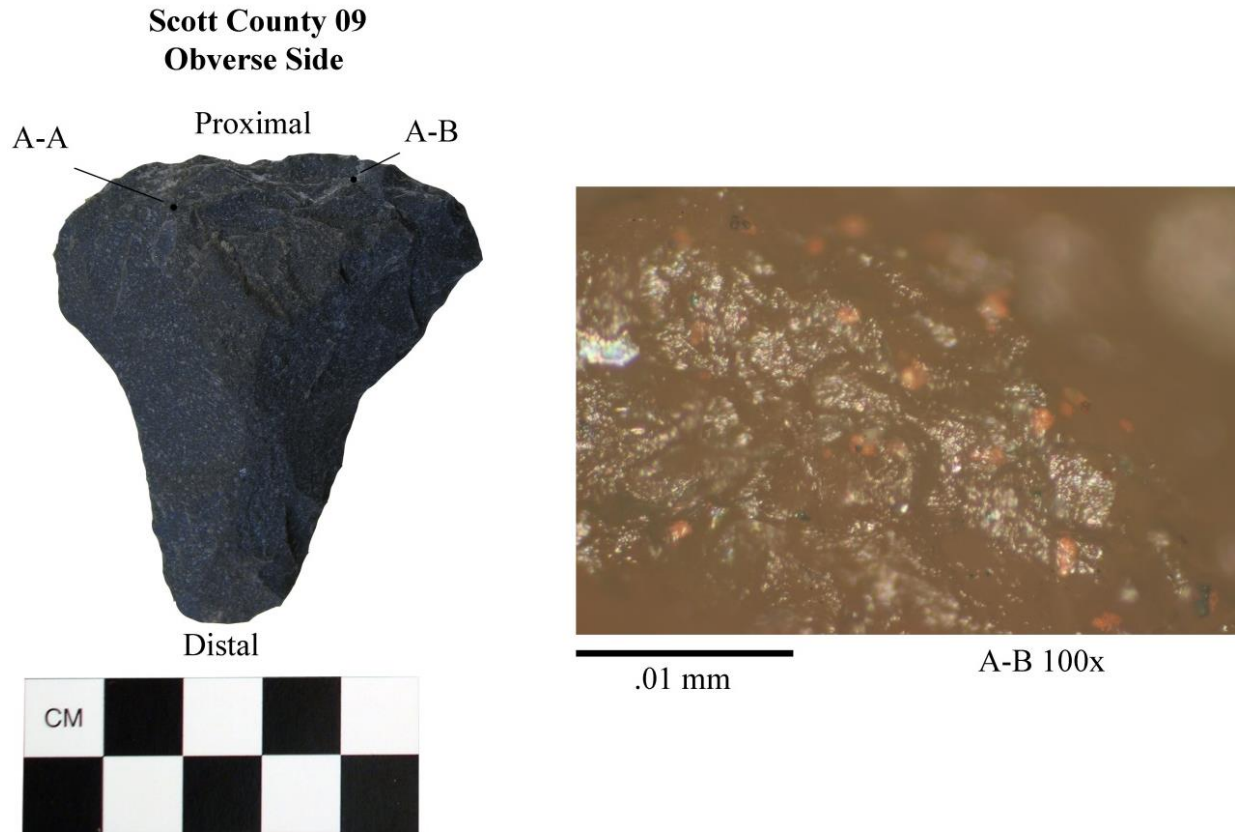


Figure 490. Experimental woodworking bit edge wear on the obverse side of Scott County 09, Location, A-B showing light abrasion.

Scott County Experimental 10

Scott County 10 is a larger double bitted replica form made of silicified sandstone (Figure 491). The tool weighs 303.9 grams and is 112.72 mm in length, 74.32 mm in maximum width, 55.97 mm in hafting width and has a maximum thickness of 30.1 mm.

Scott County 10 tool was hafted as an agricultural hoe, hafted to the handle with organic sinew, with the tool located on the top of the supportive arm of the handle. A wedge was used to better secure the tool to the handle and to stretch the sinew for better binding (Figure 492).

Scott County 10 was first used on March 27, 2013 on a ground surface with mixed naturally occurring vegetation and grasses (Figure 493). The soil in the area consisted on

naturally occurring silts and gravels. The tool worked very well as an agricultural hoe, easily cutting through the vegetation and soil. The researcher originally thought the minimal amount of hafting on this tool would cause it to fail quickly; however, the sinew held the tool firmly in place and made this tool very productive. Tool was again used on April 15th and continued to be a productive tool for agricultural use.

Use-wear

Bit edge wear consists of microplating with light striation wear and subtle generalized abrasion. Hafting wear shows generalized abrasion with few locations of microplating (Figures 494-498).



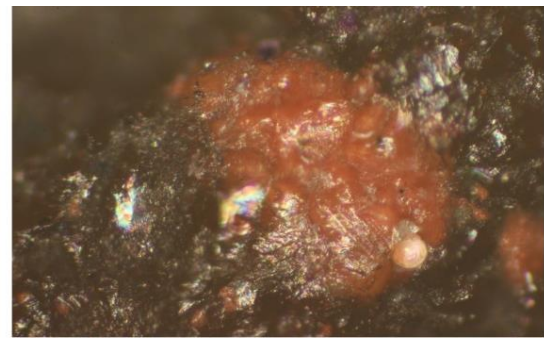
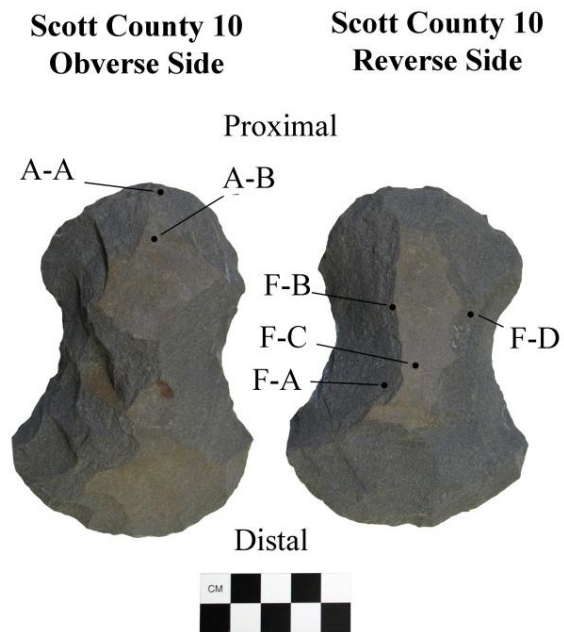
Figure 491. The obverse and reverse sides of experimental Scott County 10.



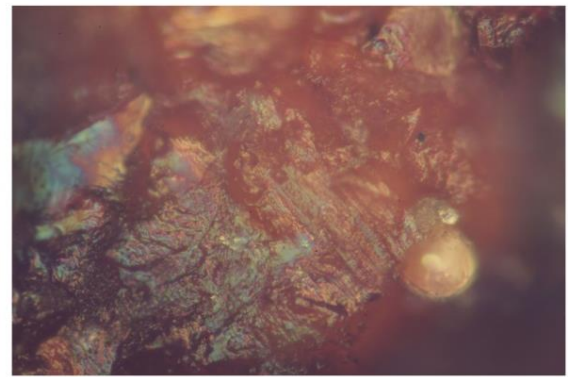
Figure 492. Experimental hafting of Scott County 10, designed as an agricultural hoe with organic sinew as the hafting material.



Figure 493. Scott County 10 experimental use. Photo taken by Nicole Schuler on March 27, 2013 in Fayetteville Arkansas.

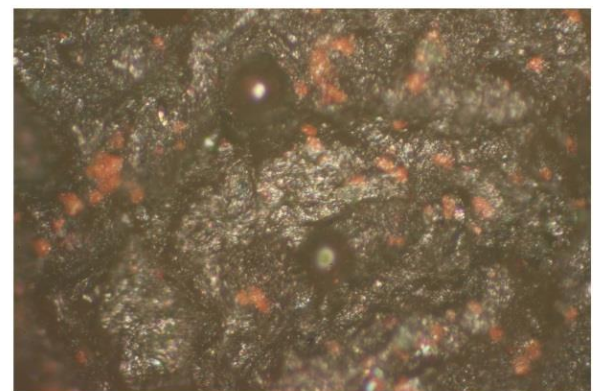
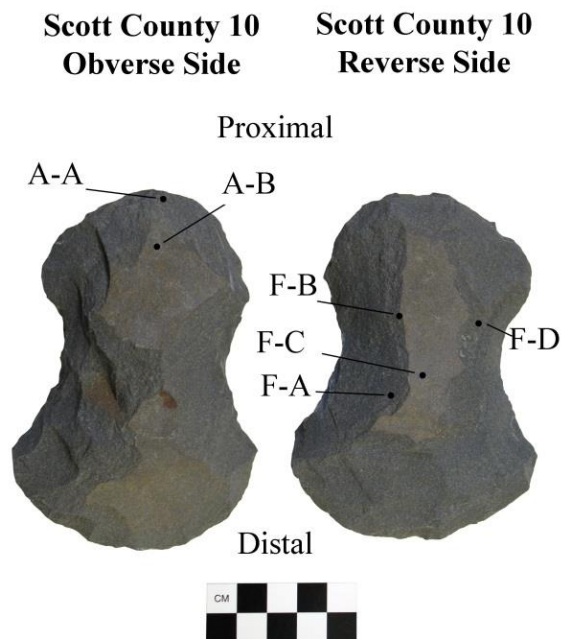


A-A 100x



A-A 200x

Figure 494. Experimental agricultural bit edge wear on the obverse side of Scott County 10, Location A-A, showing microplating.



A-B 100x

Figure 495. Experimental agricultural bit edge wear on the obverse side of Scott County 10, Location A-B, showing light abrasion.

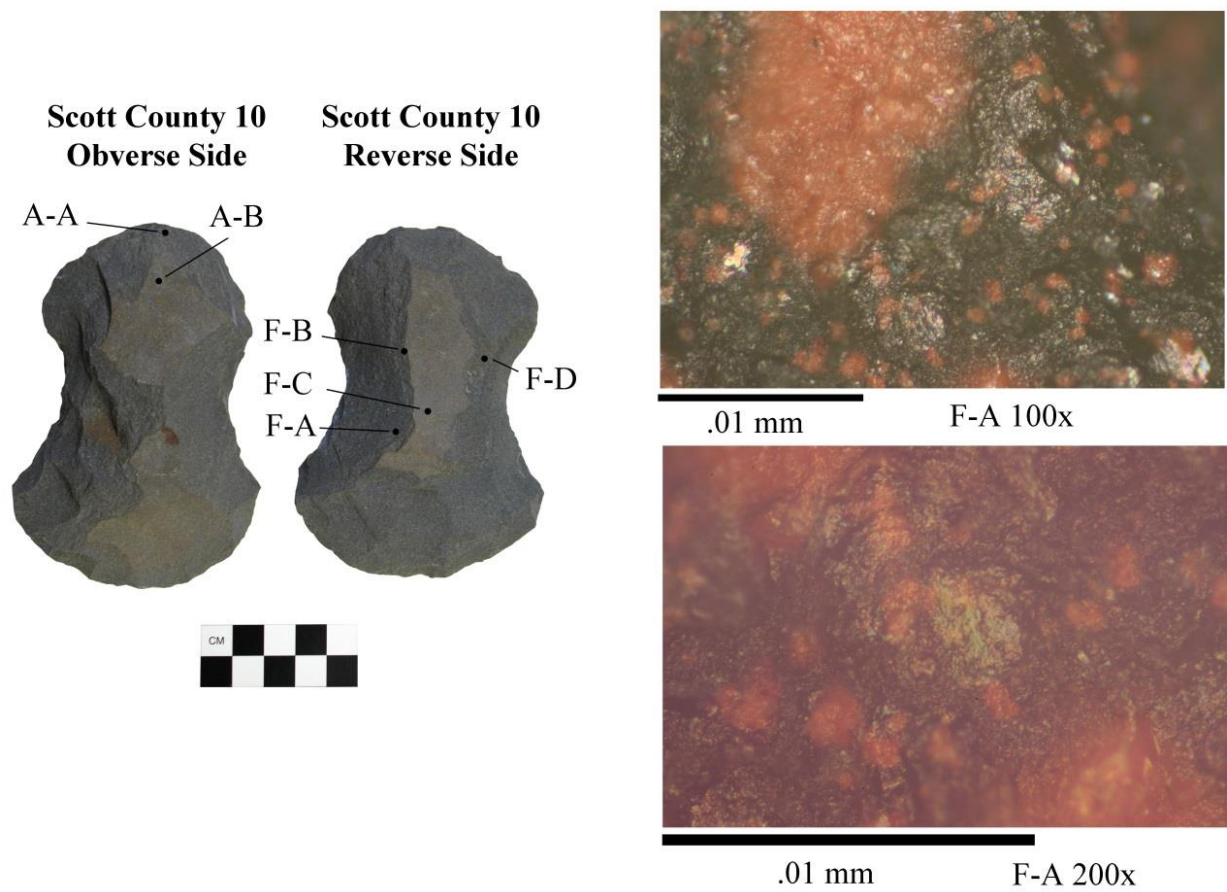
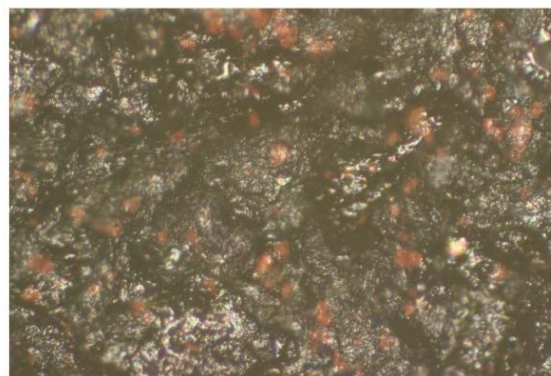
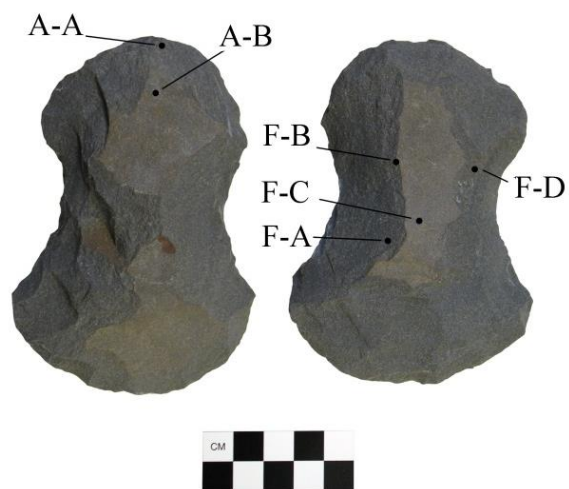


Figure 496. Experimental agricultural hafting wear on the reverse side of Scott County 10, Location F-A, showing light abrasion and the beginnings of microplating.

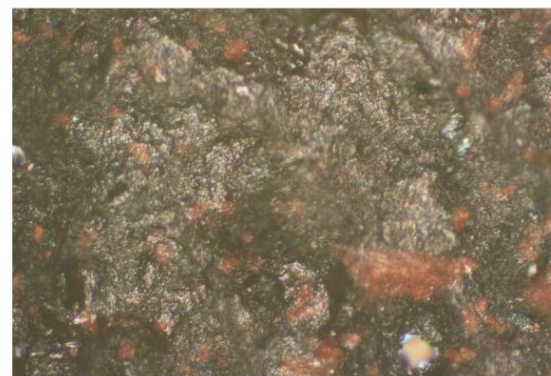
**Scott County 10
Obverse Side**

**Scott County 10
Reverse Side**



.01 mm

F-B 100x



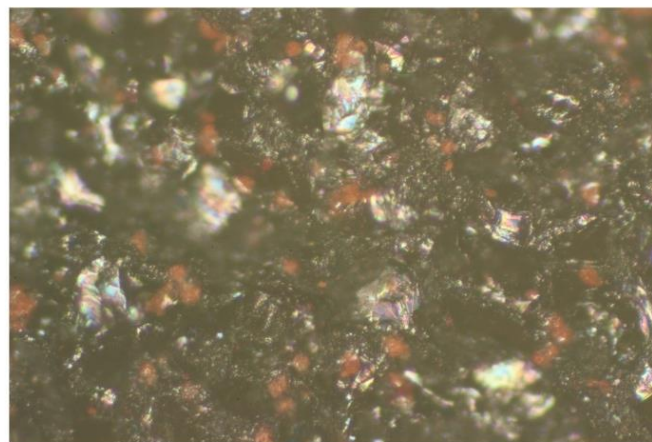
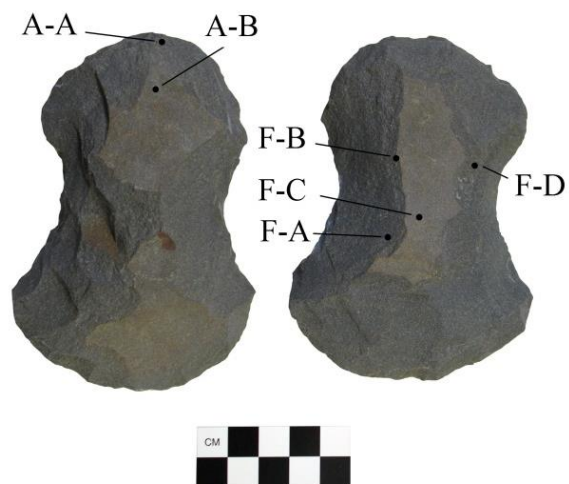
.01 mm

F-C 100x

Figure 497. Experimental agricultural hafting wear on reverse side of Scott County 10, Locations F-B and F-C, showing generalized abrasion.

**Scott County 10
Obverse Side**

**Scott County 10
Reverse Side**



.01 mm

F-D 100x

Figure 498. Experimental agricultural hafting wear on the reverse side of Scott County 10, Location F-D showing light abrasion and pseudo-wear in the form of conchoidal fractures.

Scott County Experimental 11

Scott County 11 is a single bitted replica form, weighing 106.5 grams (Figure 499). The measurements are 100.66 mm in length, 64.67 mm in maximum width near the bit, 28.02 mm in minimum width at the tip and a maximum thickness of 23.1 mm.

Scott County 11 was used on March 26, 2013 and was originally set up in an adze form hafting to be used for bark removal (Figure 500). The tool was set into the handle in a punch form where the tool was wedged into a hole in the handle. During the experimental use of this tool, the stone consistently fell out of the handle while the user was attempting to remove bark from a felled tree. The tool was modified so that the stone was punch hafted into an axe form. During use as an axe, the tip end of the tool was damaged and the tool was no longer able to function.

Use-wear

Bit wear consists of microplating wear with multi-directional striations and light generalized abrasion. Hafting wear shows light microplating wear with few striations (Figures 501- 504).



Figure 499. The obverse and reverse sides of experimental Scott County 11.



Figure 500. Experimental hafting on Scott County 11, designed for use as a woodworking axe with punch hafting.

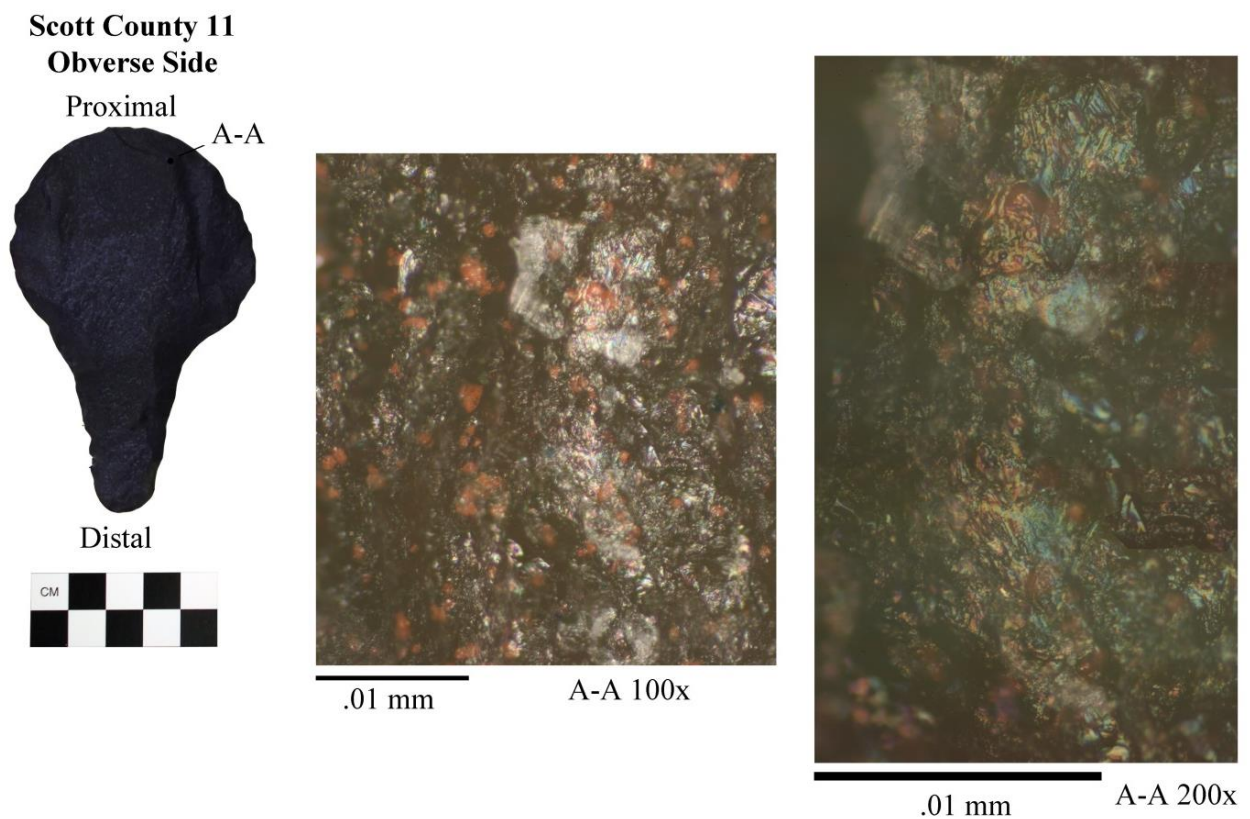
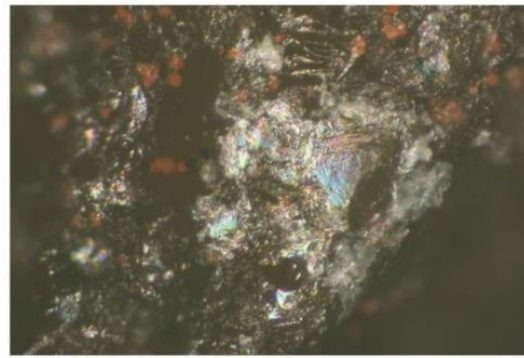
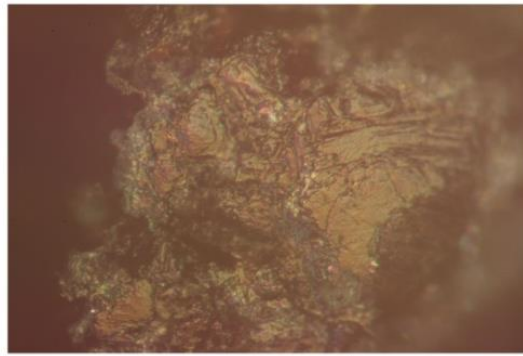


Figure 501. Experimental woodworking bit edge wear on the obverse side of Scott County 11, Location A-A, showing additive wear and light striations running perpendicular to the bit edge.



.01 mm

A-B 100x



.01 mm

A-B 200x

Figure 502. Experimental woodworking bit edge wear on the obverse side of Scott County 11, Location A-B, showing microplating.

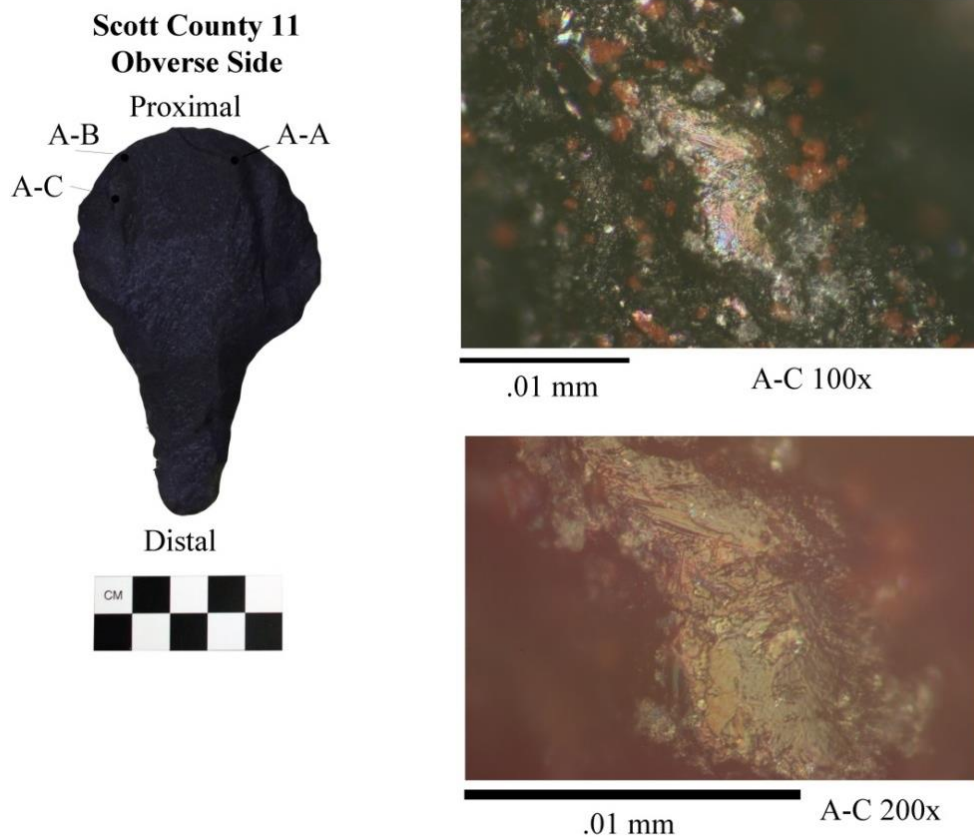


Figure 503. Experimental woodworking bit edge wear on the obverse side of Scott County 11, Location A-C, showing additive wear in the form of microplating.

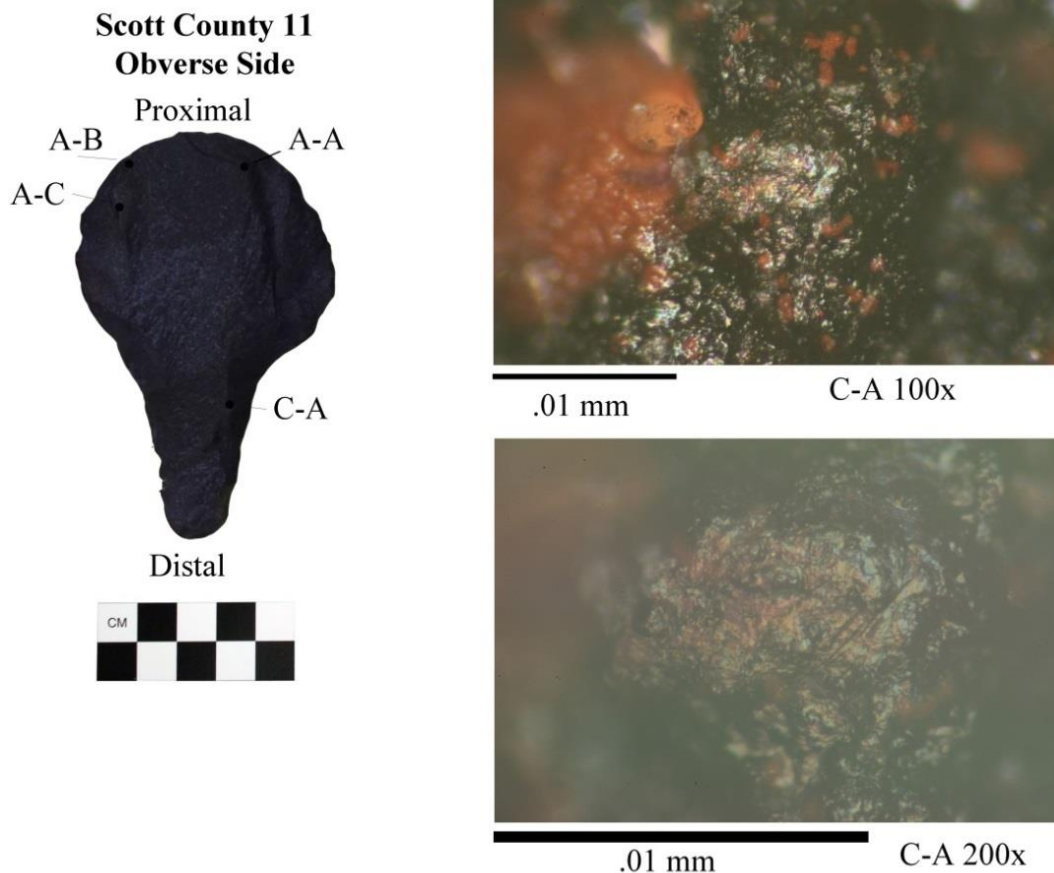


Figure 504. Experimental woodworking hafting wear on the obverse side of Scott County 11, Location C-A, showing generalized abrasion.

Scott County Experimental 12

Scott County 12 is a single bitted replica form, weighing 136.0 grams (Figure 505). The measurements are 129.95 mm in length, 53.67 mm in maximum length near the bit edge, 15.42 mm in width at the tip edge and maximum thickness of 28.2 mm. This tool was hafted in an axe form through punch hafting, where the tool was wedged into the handle through a hole which was previously drilled into it (Figure 506).

Scott County 12 worked very well as an axe and was successful removing wood mass from a small tree on March 26th, 2013 (Figure 507). After 10 minutes of constant chopping the

distal tip end of the tool broke where the tool met the wood of the handle. This rendered the tool useless as it could not be modified for re-hafting.

Use-wear

Bit edge wear shows light generalized wear with a portion having a large singular abrasive plane (Figure 508-509).



Figure 505. The obverse and reverse sides of Scott County 12.

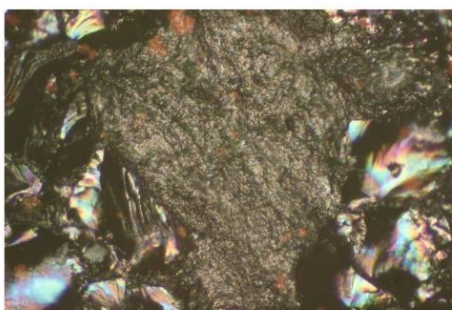


Figure 506. Experimental hafting on Scott County 12, designed for use as a woodworking axe with punch hafting.



Figure 507. Scott County 12 experimental use.

**Scott County 12
Obverse Side**



.01 mm

A-A 100x



.01 mm

A-A 200x

Figure 508. Experimental woodworking bit wear on the obverse side of Scott County 12, Location A-A, showing abrasive wear.

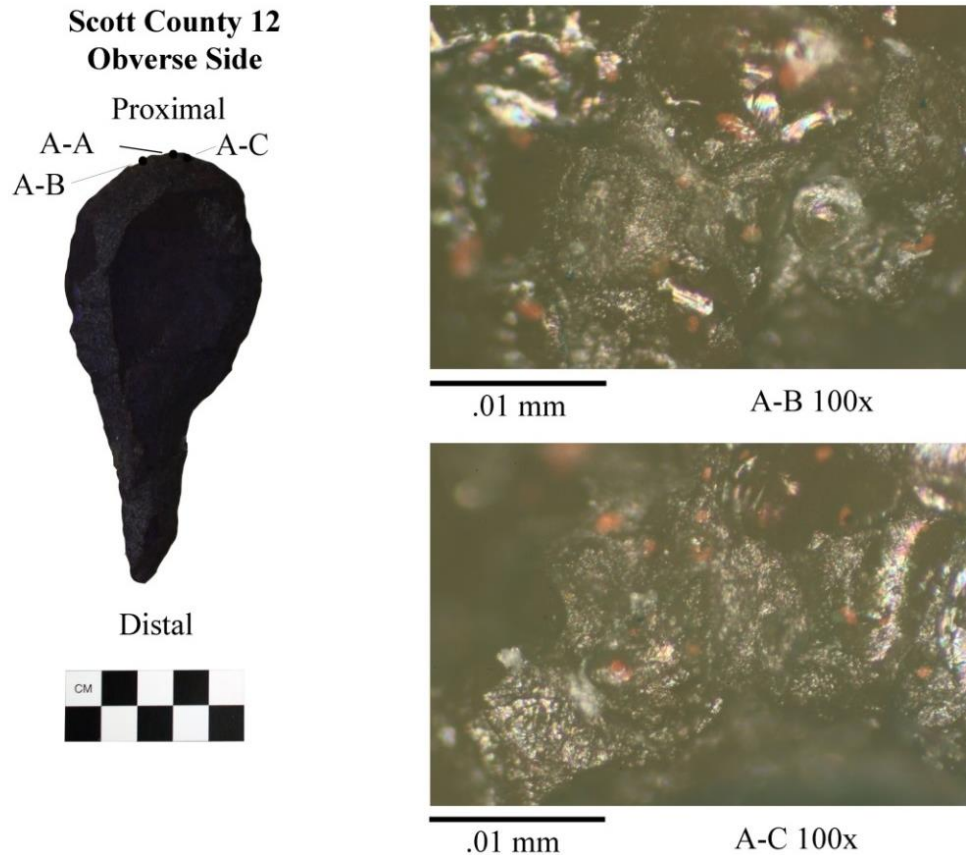


Figure 509. Experimental woodworking bit edge wear on the obverse side of Scott County 12, Locations A-B and A-C, showing generalized abrasion and the beginnings of additive wear.

Scott County Experimental 13

Scott County 13 is a smaller replica in the double bitted form (Figure 510). Originally this tool was discarded by the manufactures due to a large flake which broke off during production on the obverse side. While this did alter the symmetry of the tool, it represented many of the tools within the archaeological collection which appear to have continued to have been used even after such damage occurred. As one of the smaller tools in the collection, Scott County 13 weighs 81.1 grams and is 80.15 mm in length, 47.52 mm in max width 32.4 mm in hafting width and 21.0 mm in maximum thickness.

Scott County 13 was originally hafted in an axe form hafting, where a wedge was removed from the center of a branch and the tool was pushed down the center of the branch with the central portion/hafting portion of the tool located at the center of the handle. The tool was then held in place with stripes of processed cedar which held the tool tightly to the wood handle (Figure 511).

This tool was first used on March 26, 2013 on a small tree less than 4 inches in diameter (Figure 512). The tool worked very well to start with and easily removed the outer bark of the tree. However, as the axe was continuously used, the cedar wrappings used to secure it to the handle began to fail and the tool had to be repositioned after every hit. Through the impact of the tool on the tree, the tool shifted within the handle causing wear on the cedar bark, which eventually failed and caused the tool to no longer be productive. The stone portion of the tool did not fail and was still available to later use.

The tool was re-hafted and used again on March 27, 2013. The tool was attached to a new handle of the same form and synthetic sinew was used as the hafting material. Scott County 13 still move considerably within the hafting and the hafting again failed, rendering the tool unusable. Scott County 13 was re-hafted a third time in the same form as previously described. The tool was tightly in place prior to use, but once again began shifting immediately with use and again quickly failed in the hafting.

Use-wear

Bit edge and hafting wear consist of generalized abrasion (Figures 513-514).



Figure 510. The obverse and reverse sides of experimental Scott County 13.



Figure 511. Original experimental hafting on Scott County 13, designed for use as a woodworking axe, with a central hafting using processed cedar bark.



Figure 512. Scott County 13 experimental use.

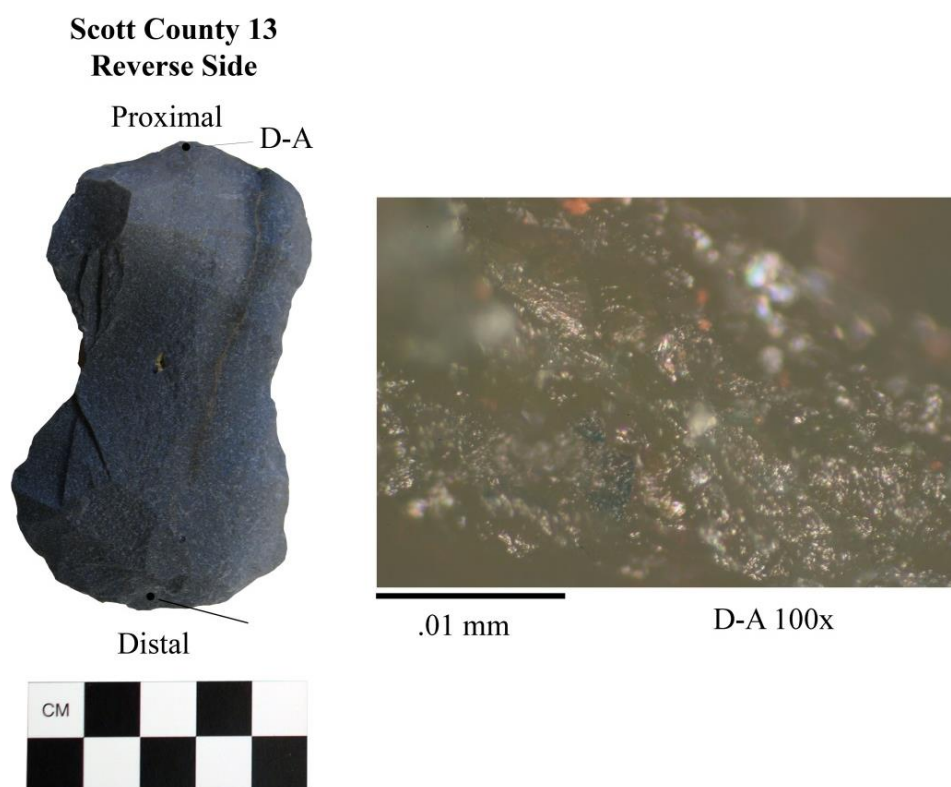


Figure 513. Experimental woodworking bit wear on the reverse side of Scott County 13, Location D-A, showing light abrasive wear.

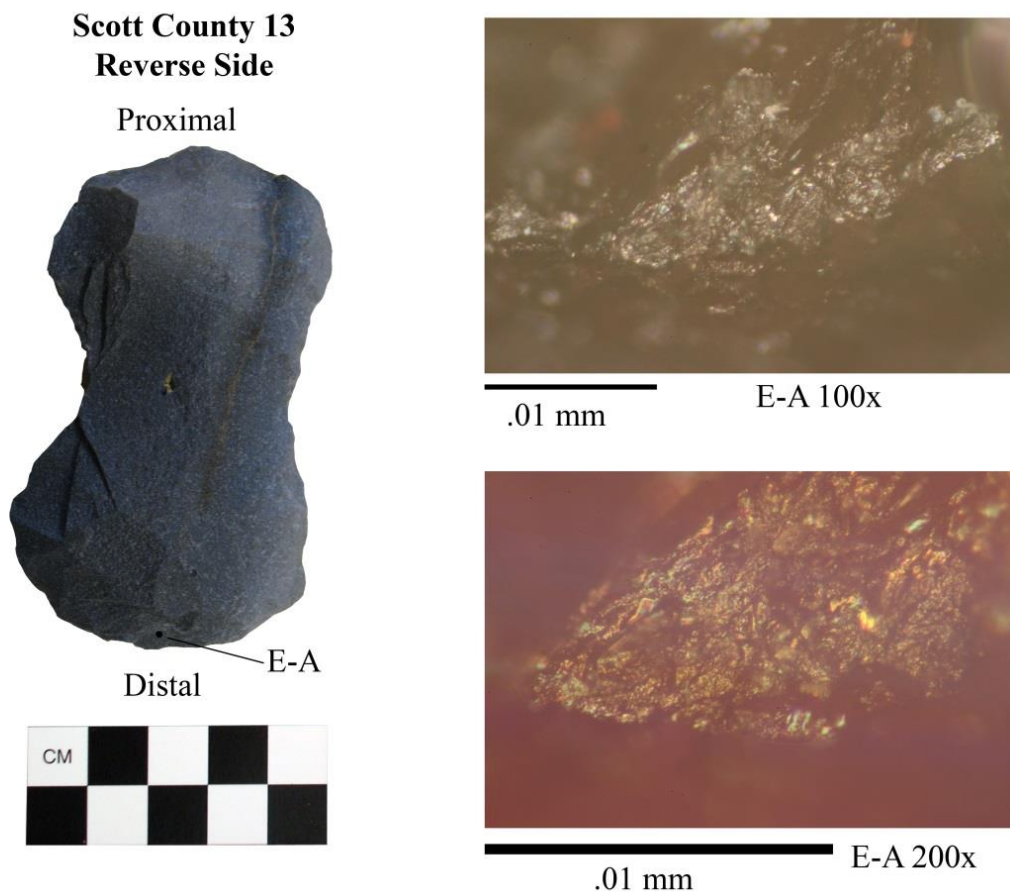


Figure 514. Experimental woodworking bit edge wear on the reverse side of Scott County 13, Location E-A, showing abrasive wear.

Scott County Experimental 14

Scott County 14 is a small replica in elongated form, weighing in at 73.4 grams (Figure 515). The measurements for this tool are 69.32 mm in length, 42.15 mm in maximum width and 21.4 mm in maximum thickness. This tool recreates a small portion of the archaeological collection which is stylized in this fashion. This tool was created to help determine if the elongated form in the archaeological record as a different form or perhaps as a way to continue use of a damaged tool. This tool was hafted in a punch form axe hafting (Figure 516).

The experimental work done with Scott County 14 on March 26th, 2013 was very successful (Figures 517-518). While it did not fell a tree, the tool was used for work on a 6 inch diameter tree, where the axe caused significant damage to the tree and had use of the tool continued the tree would have been felled. The tool did not move around in the handle throughout its use and was a very sturdy and well used tool.

Scott County 14 was used again on April 15, 2013 and again performed well until the failure of the handle. The handle split down the center after impact and was no longer useable.

Use-wear

Bit edge wear consists of light microplating wear with some generalized abrasion (Figures 519-520).



Figure 515. The obverse and reverse sides of Scott County 14.



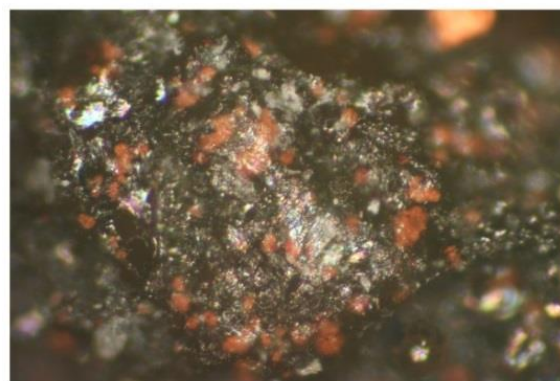
Figure 516. Experimental hafting on Scott County 14, designed for use as a woodworking axe with punch hafting.



Figure 517. Damage to the handle of Scott County 14.

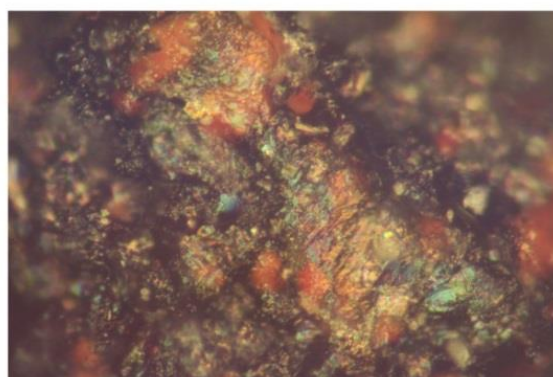


Figure 518. Experimental use of Scott County 14.



.01 mm

A-A 100x



.01 mm

A-A 200x

Figure 519. Experimental woodworking bit edge wear on Scott County 14, Location A-A, showing microplating and few partially filled in striations.

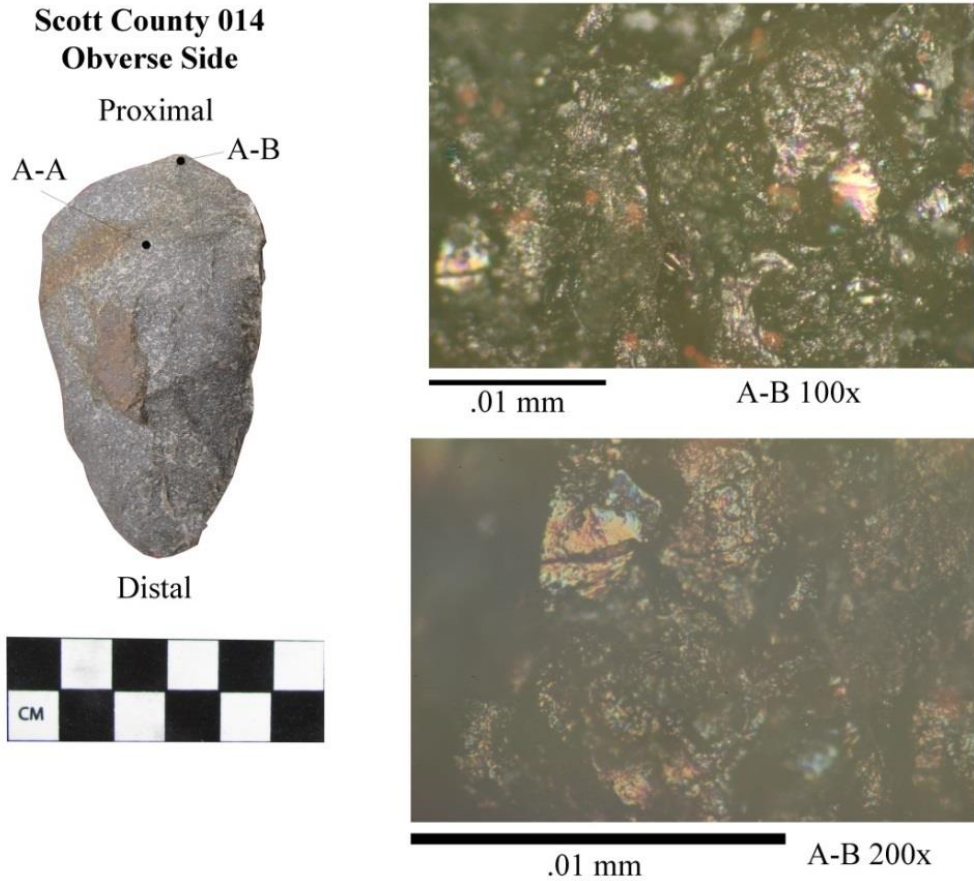


Figure 520. Experimental woodworking bit edge wear on Scott County 14, Location A-B, showing generalized abrasion and the beginning of microplating.

Scott County Experimental 15

Scott County 15 is an elongated replica form made of silicified sandstone that weighed 74.8 grams and measures 80.53 mm in length and 49.92 mm in width (Figure 521). This tool was going to be hafted in an adze form hafting, but failed during production. The tool snapped in half as it was being hammered into the handle rendering it no longer productive (Figure 522).



Figure 521. The obverse and reverse sides of experimental Scott County 15.



Figure 522. Production damage on Scott County 15.

Scott County Experimental 16

Scott County 16 is a small double bitted replica made of silicified sandstone weighting 85.5 grams with a length of 70.0 mm, a width of 49.7 mm, a thickness of 19.9 mm and a hafting width of 40.7 mm (Figure 523). This tool was going to be hafting in an axe form, but broke during production.



Figure 523. The obverse and reverse sides of experimental Scott County 16.

Scott County Experimental 17

Scott County 17 is a smaller double bit form replica made of novaculite chert weighing 70.3 grams (Figure 524). The measurements for the tool are 97.26 mm in length, 47.89 mm in width, 34.28 mm in hafting width, and a thickness of 34.3 mm.

Scott County 17 was hafted in the traditional axe hafting form on a piece of cedar wood which had the central portion of the handle shaft removed (Figure 525). The tool was then worked into this central portion and was wrapped in dried willow bark. The top portion of the cedar handle which continued past the tool were also heavily wrapped in the attempt to limit tool movement during use.

During the experimental use on March 26th, 2013, Scott County 17 worked very well as use as an axe. The material was more than capable of removing the bark and cutting into the hard wood which surrounded it. However, after some use, the tool began to shift within the handle. To counteract this, the user would flip the tool and hit first on one bit and then switch to

the other in the attempt to maintain the use of the tool by having the tool remain in the handle. Even with this necessary adaption, the tool was still capable of use. Tool failure occurred when one of the upper portions of the handle, the part which surrounded the tool, broke during use. This caused the tool to no longer be able to be used as the tool had no support for impact. Both the tool and the hafting remained intact.



Figure 524. The obverse and reverse sides of experimental Scott County 17.



Figure 525. Experimental hafting on Scott County 17, designed for use as a woodworking axe with central hafting with willow bark.

Scott County Experimental 18

Scott County 18 is a smaller double bitted form replica made of chert which weighed 46.9 grams (Figure 526). The measurements are 71.3 mm in length, 45.3 mm in width, 14.1 mm in thickness with a hafting width of 38 mm. This replica was fashioned as an adze with substantial cordage to secure it to the handle (Figure 527).

Scott County 18 was first used on May 25, 2013 against dried cow bone (Figure 528). The purpose was to determine if animal bone processing produced different wear. Unfortunately, the cow bone won the battle (Figure 529). The tool was quickly damaged during use as large flakes were removed upon impact. Little damage to the bone occurred, but the tool was quickly rendered useless.

Use-wear

Wear on this tool is substantially different from any use-wear seen on either the experimental replicas or the archaeological collection. Wear is roughly abrasive in nature with heavy scrapping (Figure 530-531).



Figure 526. The obverse and reverse sides of Scott County 18.



Figure 527. Experimental hafting on Scott County 18, designed for use as marrow extraction with adze form hafting.



Figure 528. Scott County 18 experimental use. Photo taken by Tracy Hadlett on April 2, 2013 in Fayetteville Arkansas.



Figure 529. Experimental damage to cow bone from Scott County 18.

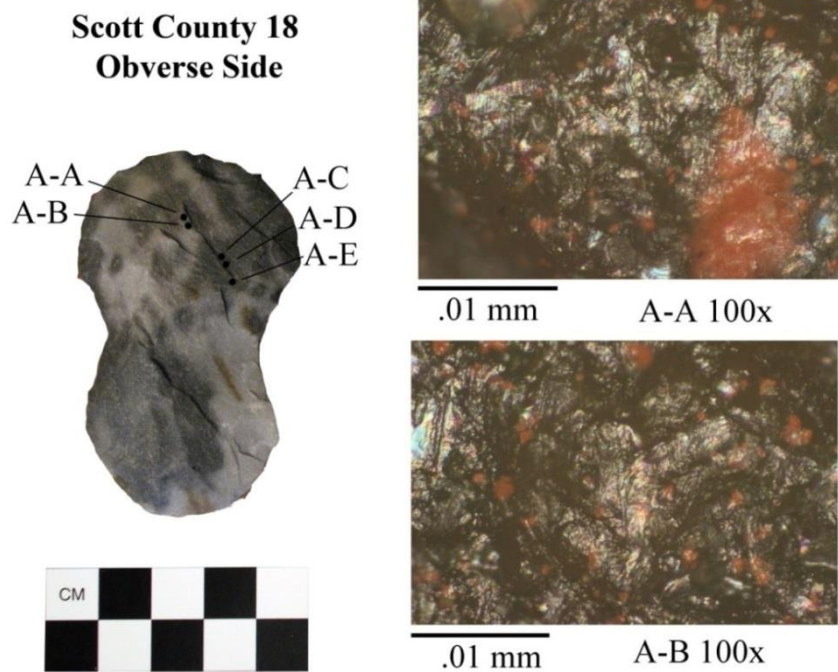


Figure 530. Experimental marrow extraction bit edge wear on Scott County 18, Locations A-A and A-B, showing plane like additive and abrasive wear.

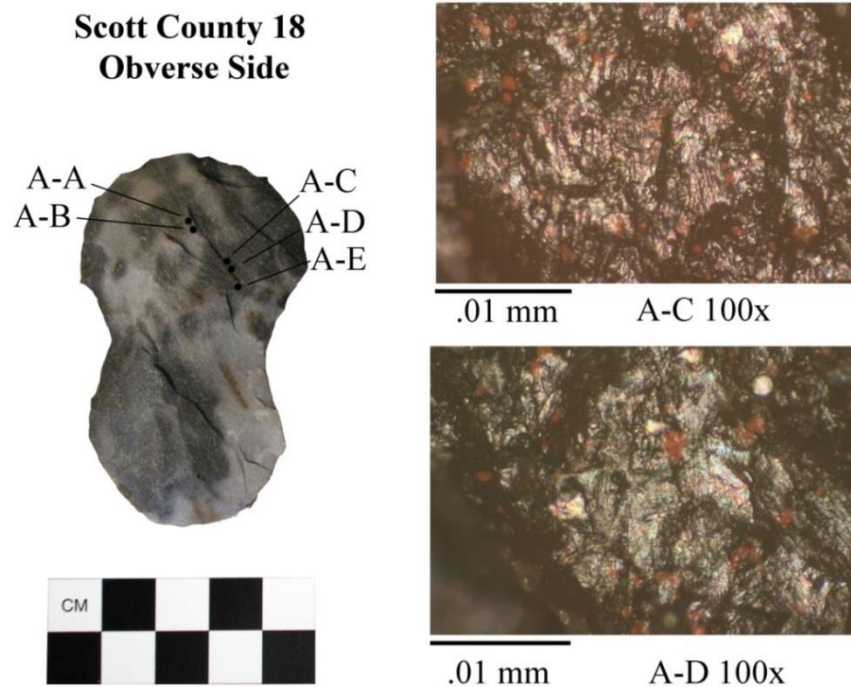


Figure 531. Experimental marrow extraction bit edge wear on Scott County 18, Locations A-C and A-D, showing plane like additive and abrasive wear.

Scott County Experimental 19

Scott County 19 is a double bitted form replica made of sandstone and weighs 174.2 grams (Figure 532). Length of the tool is 94.67 mm by 60.69 mm in width with a hafting width of 50.07 mm. This was the only tool in the experimental collection to be made of a sandstone material and it was considerably denser than the other tools.

Scott County 19 was hafted in the axe form with a piece of hickory as the handle. The hafting for this tool was slightly different than other hafting as the wood was first thinned, soaked in water for two days and then curved over the tool to completely encase the tool with one single piece of the wood handle. The majority of the hafting on this tool occurred where the thinned piece of wood met up with the larger piece of the handle. The thinned handle was responsible for the majority of holding the actual tool in place. However, some hafting occurred surrounding the tool itself as a way to stabilize the tool within the overarching handle. The

hafting was made from dried willow bark. The handle for this tool was also slightly longer than many of the other tools in the experimental collection (Figure 533).

Scott County 19 worked incredibly well during the experimental work on March 26th 2013. The folded over form of the handle gave the tool greater support and strength. However, there was still significant movement of the tool within the handle and the dried willow bark which surrounded the tool in the handle quickly failed. The best part of this tool design though was that the tool was still functional even after the failure of the tool surrounding willow due to the folded over hickory. The tool continued to shift within the handle, after continued use, the tool eventually began to damage the overarching wood and use was discontinued to limit any further damage to the handle form.

Scott County 19 was used again on April 15, 2013 and it became clear that the hafting form of the folded over handle is the most productive form used for axes in this experimental collection. Continued use of this tool however, caused significant shifting to occur and the tool was no longer able to function. With additional or stronger hafting material this form of tool would have functioned as a long term useable tool.



Figure 532. The obverse and reverse sides of Scott County 19.



Figure 533. Experimental hafting on Scott County 19, designed for use as an woodworking axe with willow bark as hafting material.

Scott County Experimental 20

Scott County 20 is a single bitted form replica made of silicified sandstone (Figure 534). The tool weighs 110.2 grams and has a length of 82.8 mm, a width of 64.09 mm and with a tip width of 21.34 mm.

This tool was hafted in an axe punch form where the tool is placed in a hollowed out section of the handle (Figure 535). For Scott County 20, the addition of modern tar was added around the end tip of the tool to ensure the tool stay within the handle.

Scott County 20 was first used on March 27, 2013 on a small tree. The tool was able to cut through the bark easily, but had more difficulty with the new growth. The size and weight of the tool made each swing more effective and helped to balance the handle better. At first the tar was beneficial as it firmly held the tool within the handle, however, the tool broke during use. This was most likely due to the fact that the tool was unable to shift within the handle, ensuring each impact to be absorbed by the tool itself instead of the handle.

Use-wear

Wear consists of generalized abrasion and localized microplating with multi-directional striations (Figure 536-537).



Figure 534. The obverse and reverse sides of Scott County 20.



Figure 535. Experimental hafting on Scott County 20, designed for use as an woodworking axe in punch form hafting.

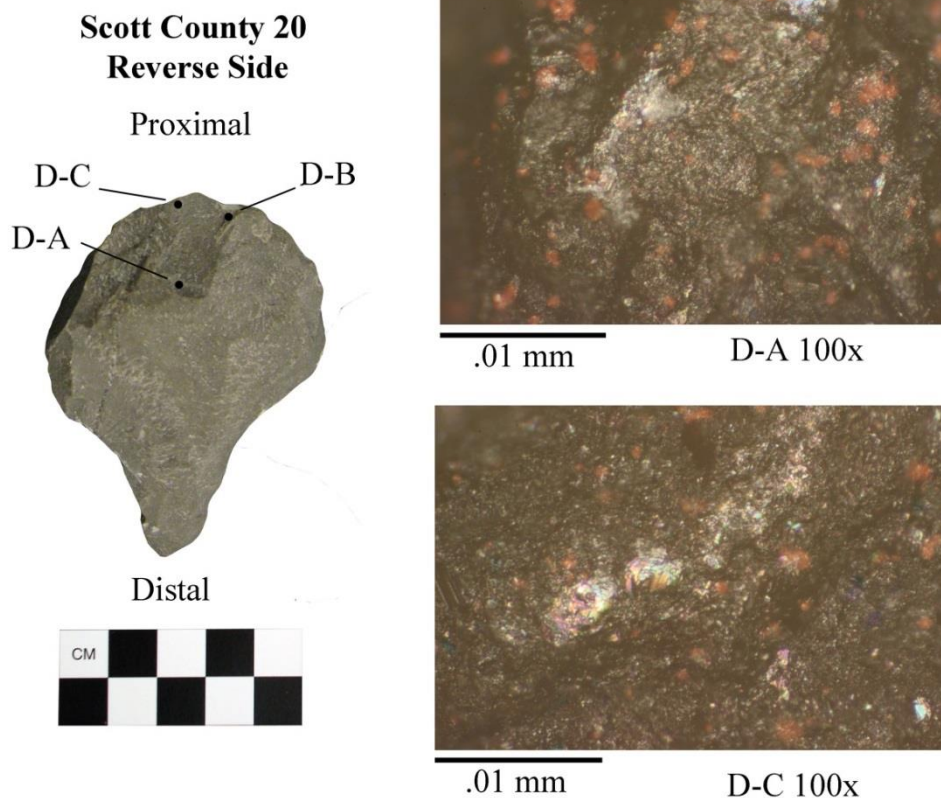


Figure 536. Experimental woodworking bit edge wear on Scott County 20, Locations D-A and D-C, showing generalized abrasion and light microplating wear.

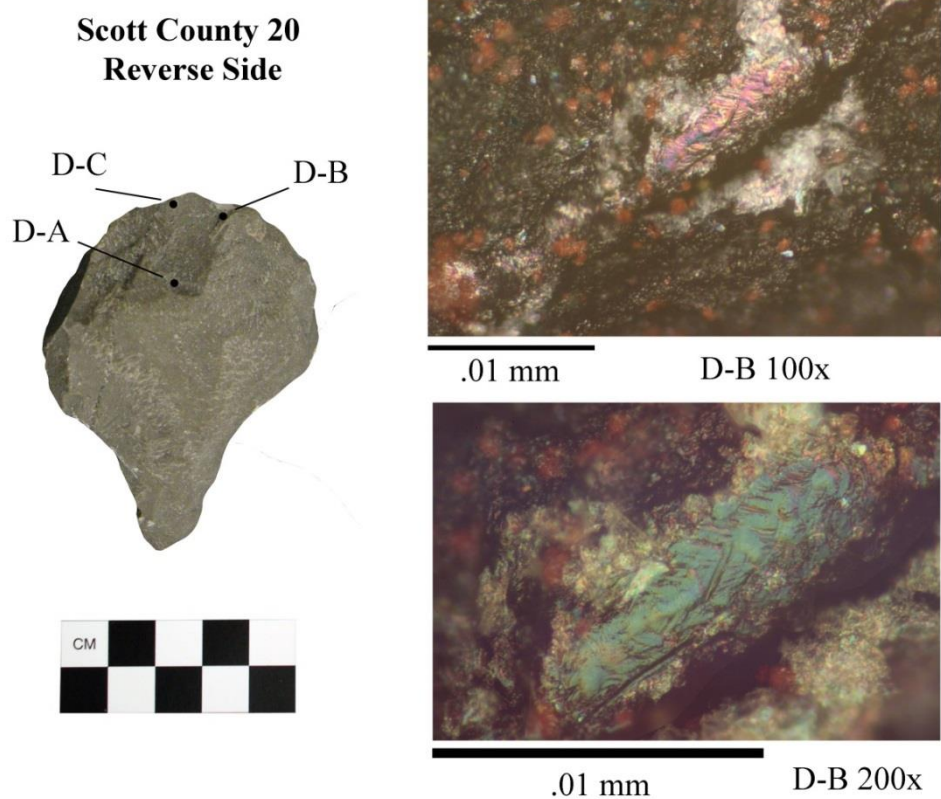


Figure 537. Experimental woodworking bit edge wear on Scott County 20, Locations D-A and D-C, showing microplating surface with multi-directional striations.

Appendix 4

Steps for Casting

A thorough cleaning of the artifacts is the necessary first step in the casting process. Microscopic material can be deposited on the tool from the extensive time spent in the ground, or from simple handling of the material by the archaeologist and the lithic analyst, which can lead to later casting errors (Banks and Kay 2003; Keeley 1980; Rots 2010). All of the archaeological material from the Fourche Valley site was thoroughly cleaned by hand with a brush and mild detergent and then allowed to air dry. Prior to casting, all material in the collection was weighed, and had measurements taken including length, width and thickness.

The first step for creating the casts of the tools consists of forming the outer edges of the molds. These edges were formed by President Putty – Soft, produced by Coltene Whaledent, which fashions the barriers in which the mold material would be placed. These barriers determine the size, shape and any wear which would be encompassed within the mold. The molding gel bonds against the putty material, which is beneficial to the process for two reasons. First, the putty allows for the easier removal of the molds once dried. The gel from which the molds are made can tear quite easily and the placement of the putty surrounding the mold gel helps to eliminate this error. Second, the putty edges are later used as a base for the walls along the edges of the mold, forming the barriers which contain the epoxy used in the making of the casts.

Location of where the molds were placed was systematic and remained consistent throughout the study (Figure 14). If both proximal and distal edges were present, then both would have casts taken in the central portion of the bit. If the hafting portion of the tool was intact this area was also molded in an attempt to see any hafting wear (Figure 538). Of course,

this process did not work on every tool, due to damage or loss of portions of the tool at some point in its history. For certain tools, only one edge was present, and therefore, only one cast was obtained. The side of the tool from which the cast was taken was determined based off of a macro-analysis of the tool. It is not always clear where on the tool the working has occurred and most tools have multiple locations where wear is present (Knutsson and Hope 1984). If polish was visibly seen this was incorporated in the casting location as well as any obvious visual wear.

The molds of the tools were created with a polyvinylsiloxane gel manufactured by Coltene-Whaledent president light body. This is a silicone-based impression material used in dentistry with the main purpose being for dental casting. The gel comes in paired tubes, of which the two chemicals present react as they are mixed during application of the gel. The gel is capable of reproducing features visible up 10,000x magnification and maintains its integrity as long as exposure to UV light is kept at a minimum (Banks and Kay, 2003; Igreja 2009, Coltene website).

The surface areas and edges of the artifacts already determined by the placement of the putty were then covered by this gel, producing the mold of the artifact. A significant amount of gel was used and applied directly onto the artifact from the tube dispenser where it would adhere to the predetermined putty edges. In this study, small pieces of clear plastic saran wrap were used to ensure that all edges and crevasses on the tool were accurately filled. The plastic wrap allowed the gel to be compacted down and pushed into areas of need without damaging the mold or having the gel become stuck to the researcher's fingers. This method resulted in lower errors caused by air bubbles in the mold, or errors in the original dispersal of the gel material on the tool. The molds should be allowed to dry for a minimum period of 5 minutes, longer if they are large or have considerable depth to them, after which time they can be carefully removed from

the artifact. The edges made by the putty assisted in the removal as it reduced the tearing of the gel material mold, which can be delicate if attempted to be removed on its own. Handling of the molds must also be done with considerable caution. The inside of the molds should not be touched as a slight fingernail scrape could affect the gel material and modify what use-wear is later seen on the casts.

Molds were stored in plastic archival bags, each tagged with artifact number, the cast number, and the location from where the mold was taken on the tool. Molds were then stored in UV safe archival boxes until needed for positive casting. Photographs were taken of the molds location on the tools to verify and document all casting locations.



Figure 538. Example of mold placement on Artifact 001

The actual casting of the stone tools consist of measuring by volume the epoxy chemicals made by Epoxy Technologies. The market for these chemicals is for electronics assembly and fiber optic use. For this study, Product 301-1, parts A and B, was used. The mixing of the two chemicals creates an epoxy blend which when poured into the molds, produces a positive cast which contains all of the microscopic use-wear present on a tool. Prior to mixing of the casting material, the molds must be set out and ready to be filled once the mixture is complete. This should be done over a thick layer of newspaper as the epoxy mixture can leak through holes in

the molds or user error can result in spillage. Since the mixture is slightly volatile, the newspaper layer also allows for easy clean up and removal. While the molds are being laid out, it was beneficial to check for any small holes which would allow epoxy to leak out and to reinforce these with the putty.

The mixture needed for creating the casts consists of four parts of the Part A solution to one part of the Part B solution with a small amount of coloring dye to aid in the visual identification of the use-wear. This epoxy solution was measured by volume in disposable cups. The amount of Part A used was determined by the number of casts being made at a time. Batch volume was usually kept small, to ensure less error if there was an issue with a certain batch. All batches were recorded as to how much Part A, Part B and coloring additives were used (Table A-3, Appendix 1). Once the Part A was weighed, a small amount of coloring additive, Premium Pigment by TAP Plastics Inc., was mixed in using a glass or wooden stirring stick. The coloring additive was a minimal amount, usually only 2 ounces per 50 ounces of the Part A solution. The coloring turns the cast a reddish orange color and aids in determining differences in depth when observing the tool through the microscope. Once the coloring additive and the Part A solution were mixed thoroughly, Part B of the epoxy solution was added. The coloring must be added prior to the addition of Part B, or the epoxy could start to react before the coloring can be added. Part B was added as $\frac{1}{4}$ part of the Part A solution. The 4:1 ratio is necessary for reducing the number of air bubbles formed in the casts once they have dried. Most casts will contain at least a few bubbles, however, maintaining the 4:1 ratio between Parts A and B helped to greatly reduce this error. Once the correct amount of Part B was added to the Part A/color solution, substantial mixing was necessary. A minimum of 2 minutes was required; however, stirring up to four minutes achieved greater stability of the mixture. Once the Parts were thoroughly mixed, the

epoxy mixture was poured from the cup into the molds. A steady hand was required, as a smooth even pour also resulted in minimizing of air bubbles within the casts, as well as reducing the amount of wasted epoxy mixture due to over pouring of the mold. Once the casts were poured the molds were carefully moved to a fume hood to dry. The casts, depending on thickness and size, usually took about one week to dry.

Once the casts were removed from their molds, the length and width dimensions were recorded for each cast (Table A-2, Appendix 1). Casts were stored in archival bags with labels stating the cast number, the artifact number and the cast location on the tool. Casts should be stored out of UV light to ensure a prolonged shelf life.